Measuring Fugitive Emissions of Hydrocarbons at Gas Processing Plants

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SMART THINKING.
POWERFUL SOLUTIONS.

Objectives of this project

- demonstrate new optical methods to:
  - measure fugitive emissions of hydrocarbons
  - locate leaks
- apply methods to reduce fugitive emissions
- compare measured emissions with estimated emissions

Optical Methods

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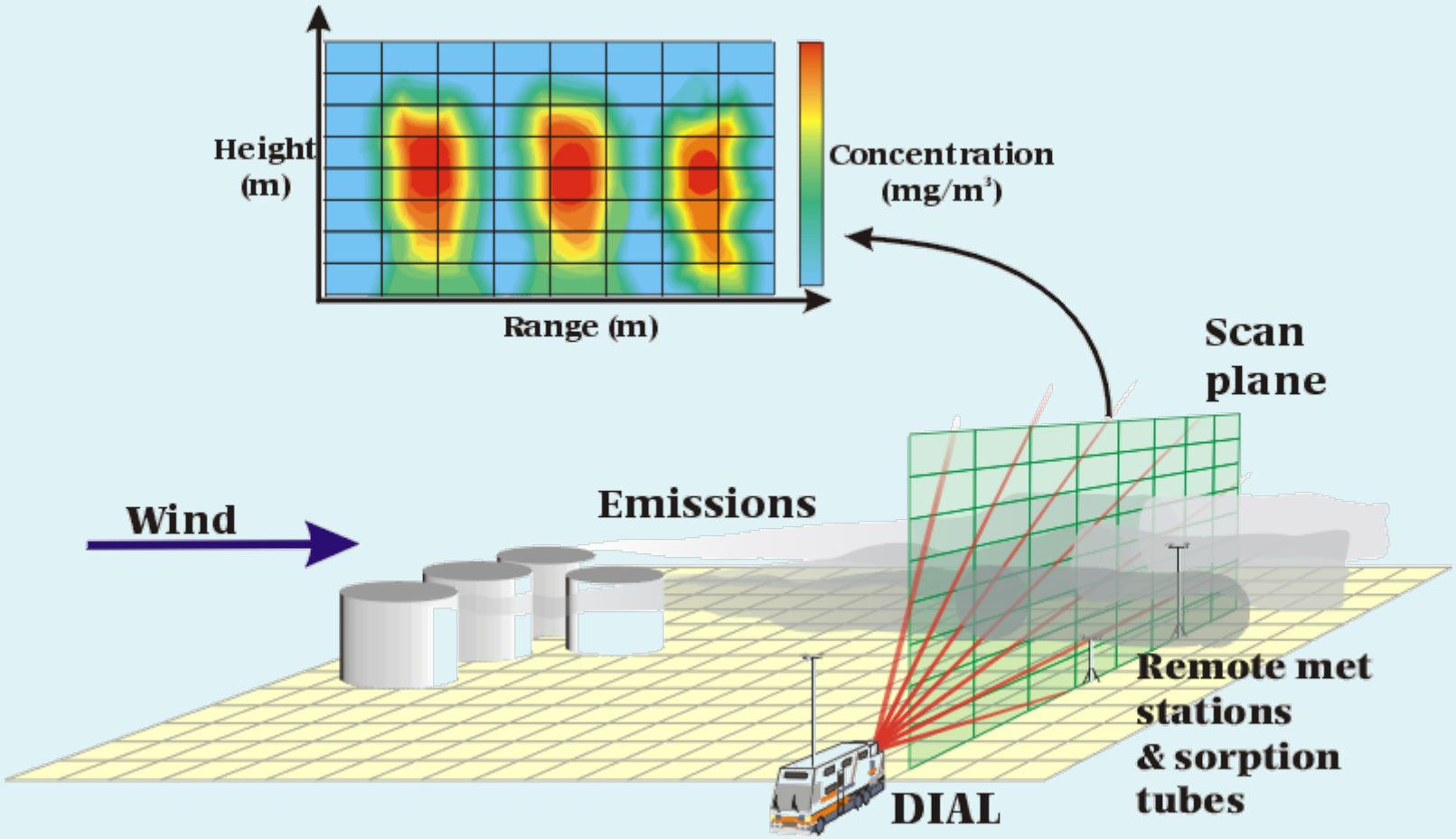
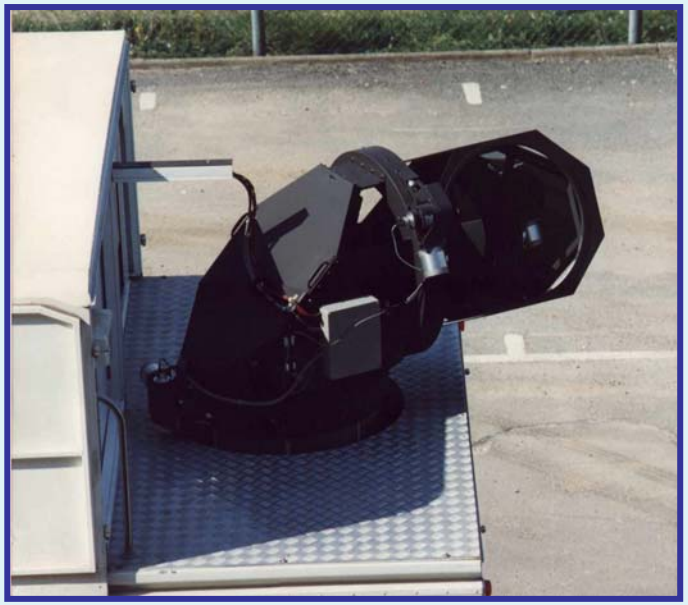
- Differential Absorption Light Detection and Ranging (DIAL)
  - laser-based, remote measurement of gas concentration
  - quantify hydrocarbons in emission plume
- Gas leak imaging camera
  - modified infra-red video camera
  - video identification of hydrocarbon leaks

DIAL Measurement of Fugitives

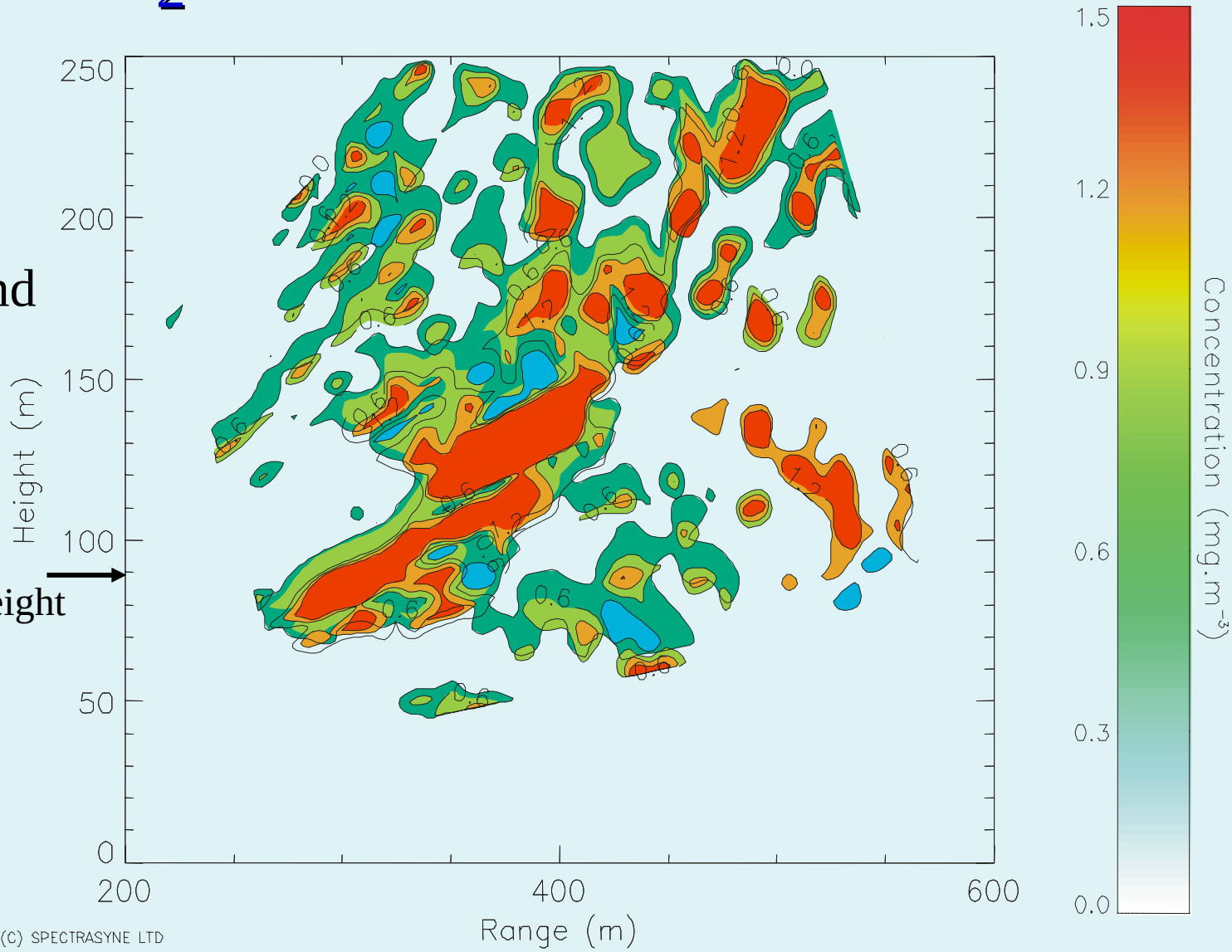


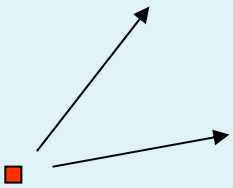
DIAL (www.spectrasyne.ltd.uk)



SO_2 Plume from Stack

plume
cross section
300 m downwind





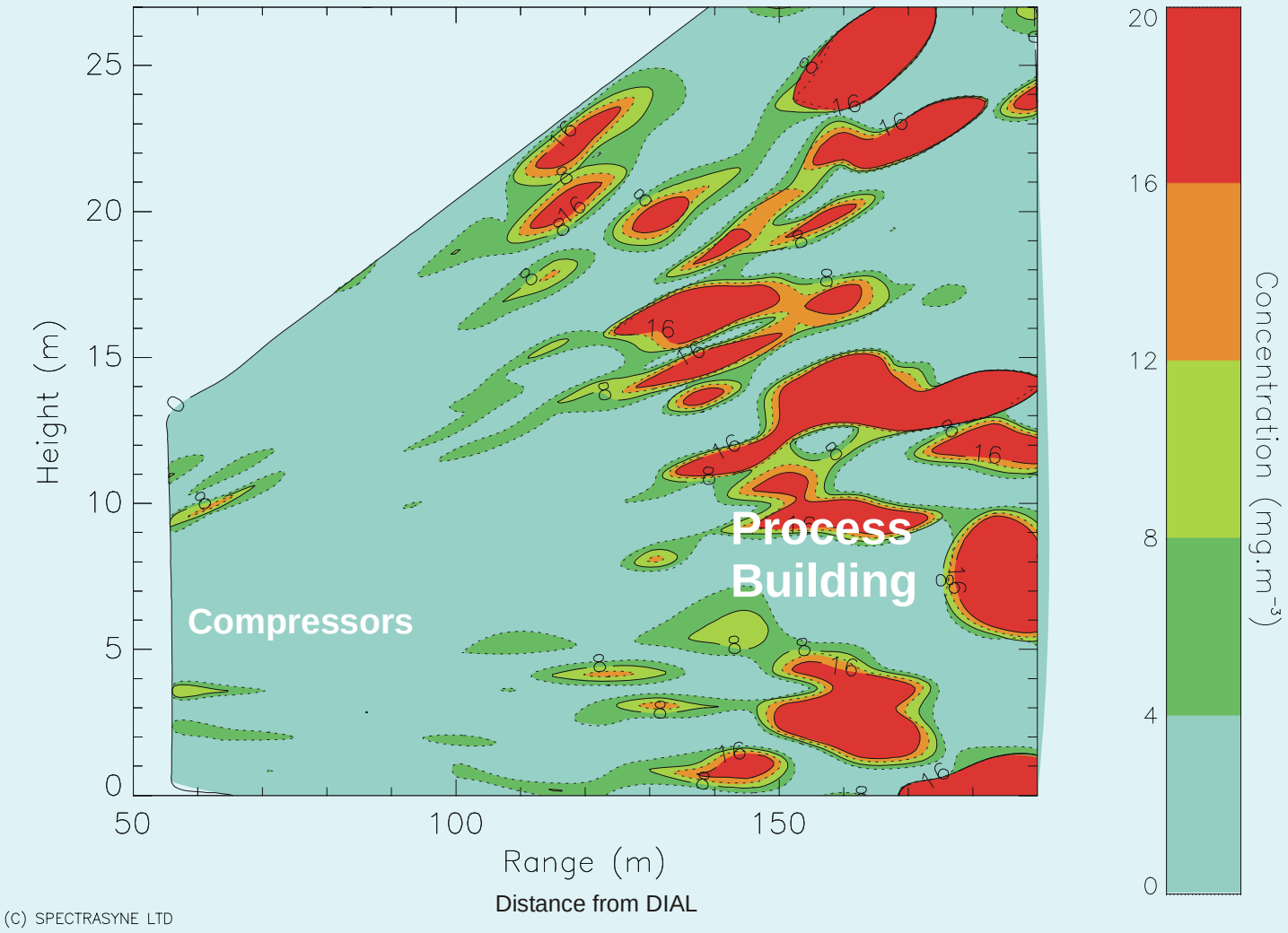
DIAL

Validation of Spectrasyne's DIAL

- in Europe:
  - six validation studies with CH_4 or C_{2+}
  - DIAL mass emissions within -3 to -12%
- in Alberta:

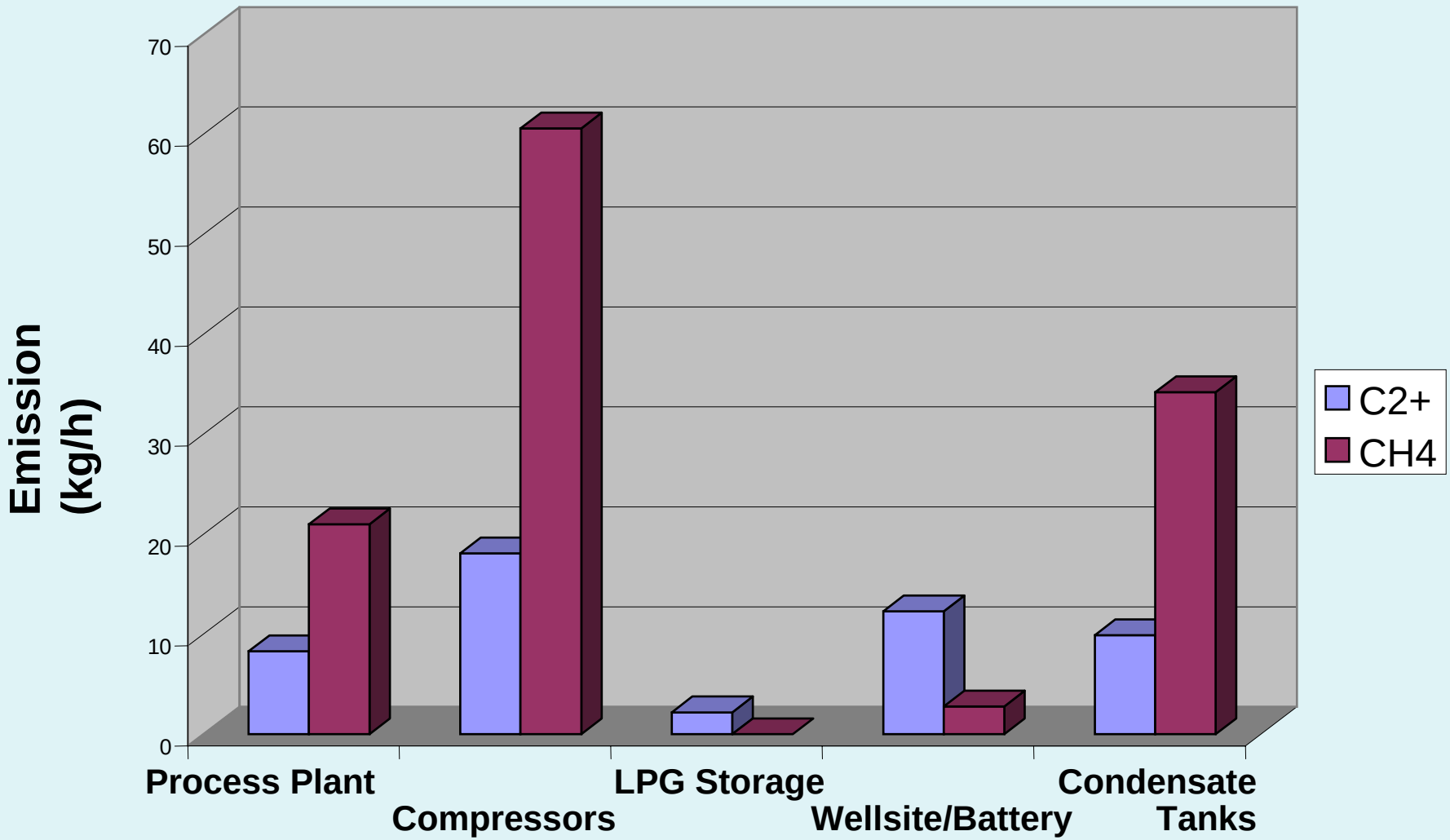
Source	Stack Monitor (kg/h)	DIAL (kg/h)	delta (%)
SO_2 from incinerator	340	304	-11
NO from gas turbine	66.5	67.1	+1

Allocating Fugitive Emissions



C_{2+} Emissions from a Gas Plant

Emissions at Sweet Gas Plant



DIAL Surveys at Alberta Gas Plants

Plant	CH_4 Emissions (kg/hr)	C_{2+} Emissions (kg/hr)	Benzene (kg/hr)
A	-	38	-
B	104 (450)	42	-
C (2003)	146	342	-
C (2004)	100	58	0.24
D	124	86	-
E	144	41	0.06

- process flares account for 10 to 15% of CH_4 emission
- 100 kg/hr equals $270,000/yr at $6/GJ

DIAL Method Summary

- directly measure fugitive emissions of:
  - CH_4
  - C_{2+} hydrocarbons (VOCs)
  - benzene
  - SO_2, NO_x, mercaptans
- locate areas of plant with highest emissions
- locate and quantify large leaks
- measure fugitives from total site

Gas Leak Imaging Cameras

2005 FLIR model

- Hawk camera by Leak Surveys Inc., Texas
- visual indication of hydrocarbon leak, no quantification

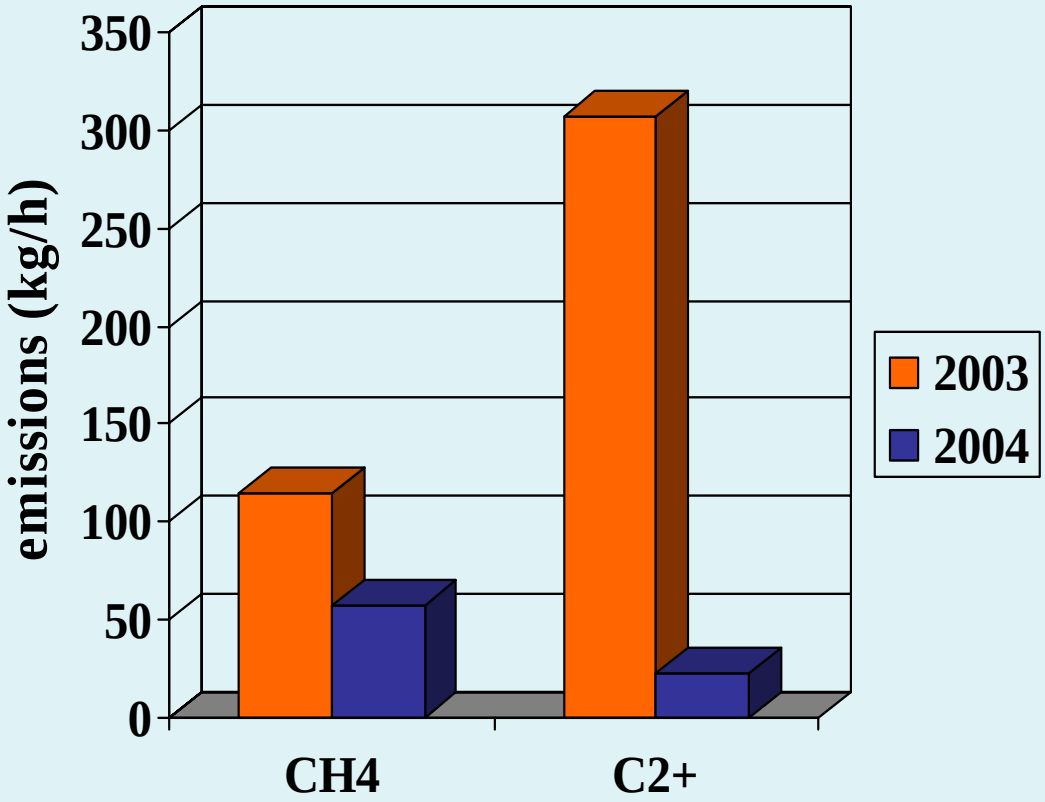
Leak Reduction at a Sour Gas Plant

- DIAL survey in 2003
- leak camera survey found 33 leaks and most repaired

- DIAL survey in 2004
- leak camera survey found 7 leaks

Reduced Emissions at Gas Plant

- CH_4 emissions reduced by 50%
- C_{2+} emissions reduced by 93%
- > $800,000/year at $6/GJ



Comparison with Estimates

- estimation methods used when reporting fugitive emissions to regulators
- Canadian Association of Petroleum Producers recommends methods based on API Emission Factor procedures

Measured vs. Estimates

Plant	Estimated	DIAL Measured
	Methane (tonnes/y)	
Sweet Gas Plant E	188	1264
Sour Gas Plant C	251	1020
	VOCs (tonnes/y)	
Sweet Gas Plant E	14.9	129
Sour Gas Plant C	94.4	545
	Benzene (tonnes/y)	
Sweet Gas Plant E	0.45	0.52
Sour Gas Plant C	0.39	2.10

Measured vs. Estimates – VOCs at a Sweet Gas Plant

Item	Estimated Emissions (tonnes/y)	DIAL Measurement (tonnes/y)
tanks	4.91	11.0
flare	0.72	8.5
combustion sources	4.93	-
plant fugitives	2.69	107.1
other	1.63	2.6
Total	**14.8**	**129**

Refinery VOC Emissions (preliminary)

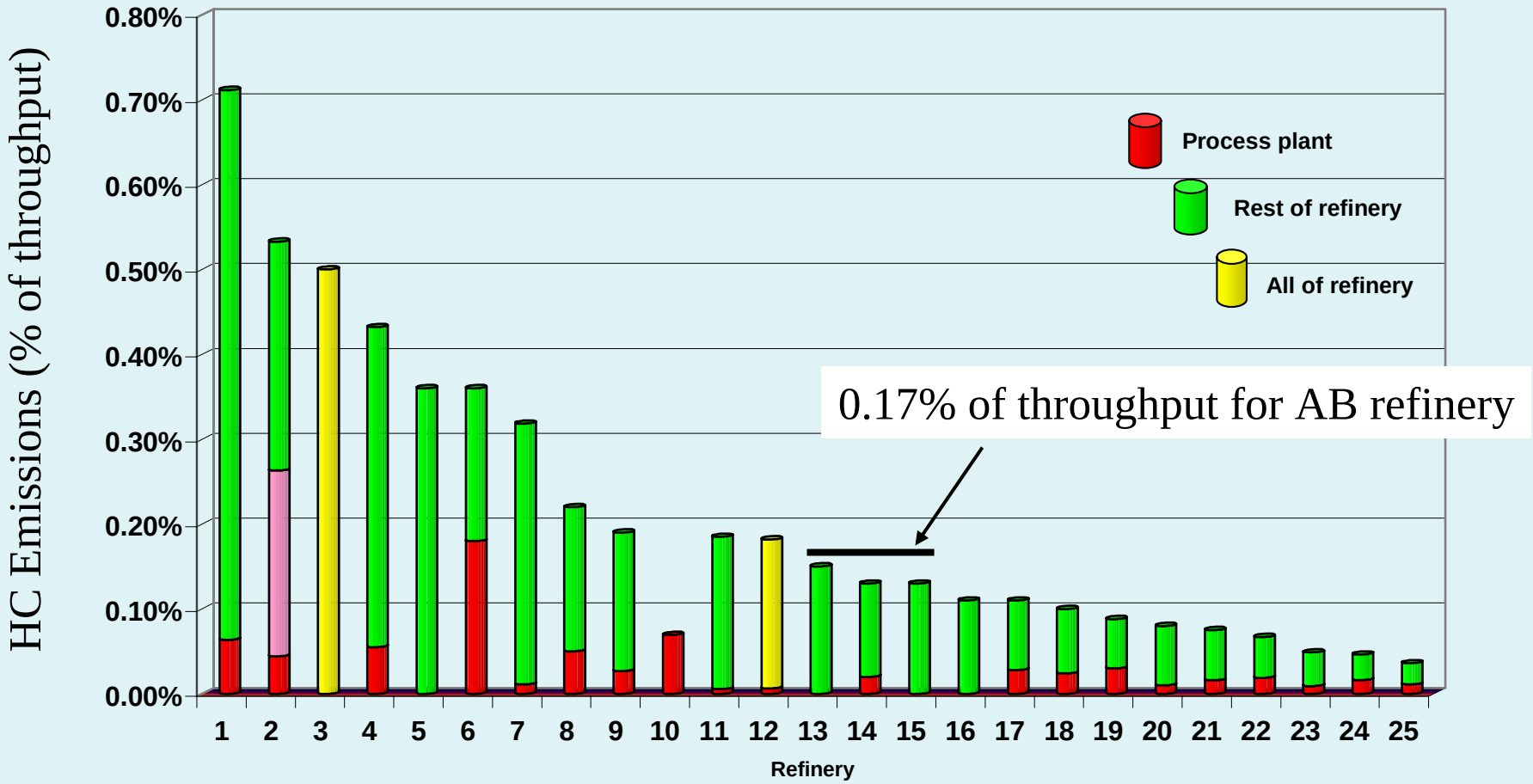
	Estimated Emissions (tonnes/y)	**DIAL C_{2+} Measurements[1] (tonnes/y)**
stack or point release	98.69	N/A
storage or handling	153.0	5,090
fugitive releases	407.1	4,880
spills	11.5	N/A
Total	**670.4**	**9,970**

1. measured hourly emissions x 8,064 hours

DIAL Measured C_{2+} (VOC) - Refinery

Area	C_{2+} (kg/h)	% of total
coker + vacuum unit	211	17.1
new process area	68.3	5.5
old process area north	105	8.5
old process area south	56.8	4.6
cooling towers	164	13.3
feed tanks	141	11.4
intermediate tanks	68.7	5.6
product tanks	277	22.4
new tanks	137	11.1
bullets and spheres	7.4	0.6
Site total	**1237**	

Emissions, European Refineries



Project Conclusions

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- DIAL can quantify fugitive emissions
- gas visualization cameras can improve leak detection
- DIAL gas processing plant measurements were 4 to 8 times CAPP detailed estimates
- storage tanks and flares were larger sources than indicated by estimation methods
- potential to recover significant $'s of fugitive hydrocarbon emissions

Acknowledgements

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