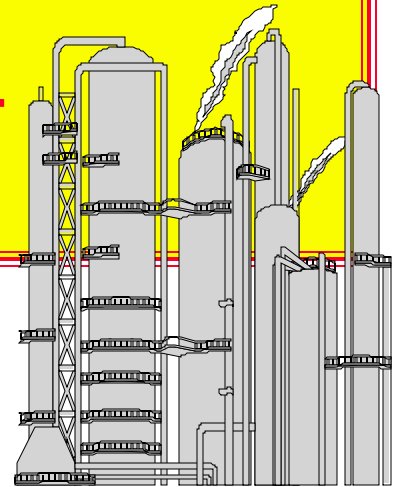
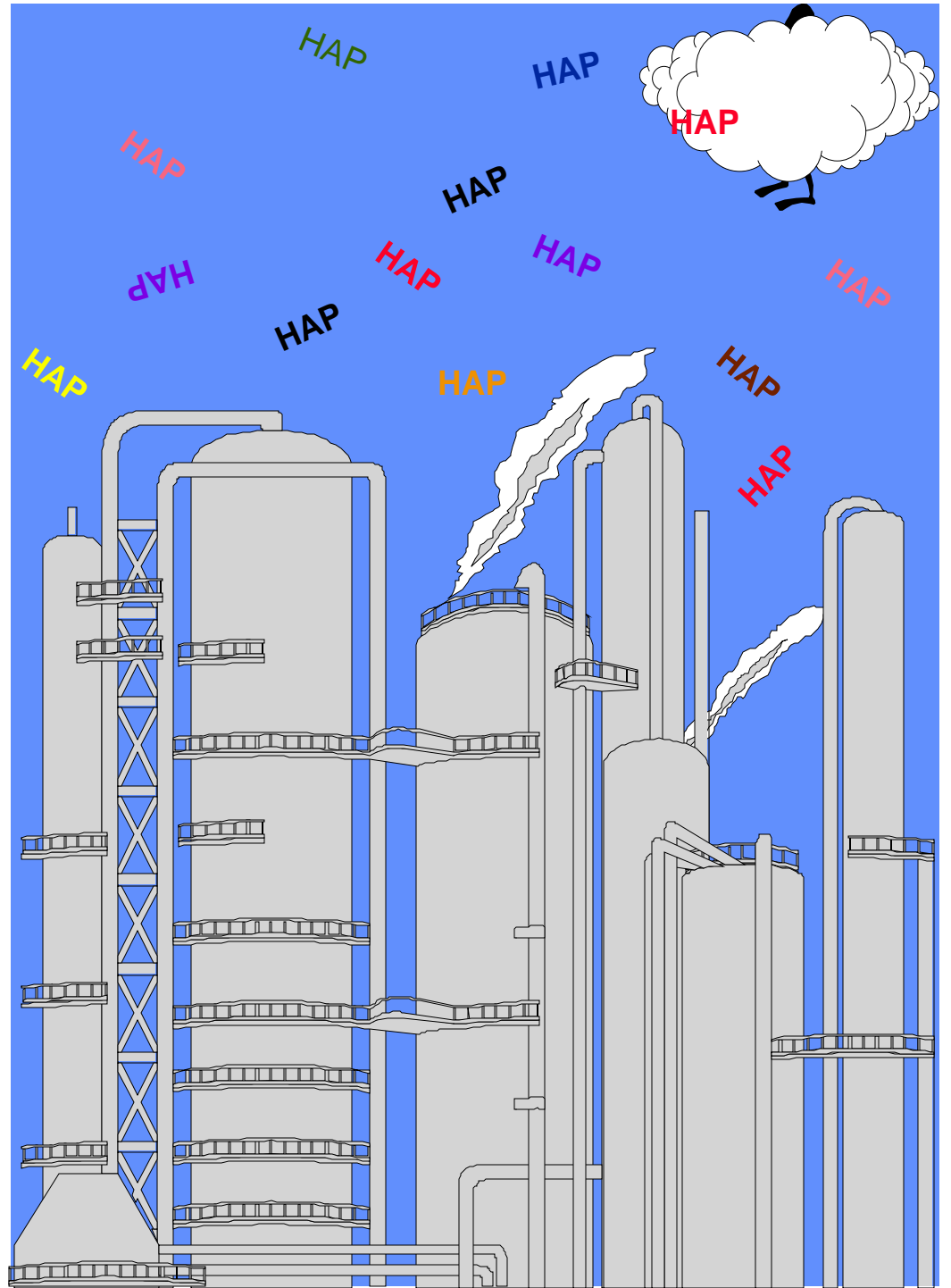
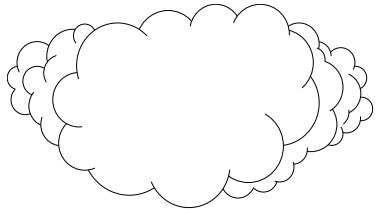


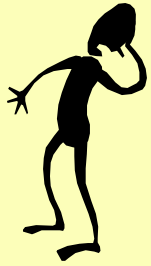
EMISSION INVENTORY APPLICATIONS OF REFINERY STREAM SPECIATION DATA

Ileana Rhodes / John King / Margaret Western

PERF COOPERATIVE AIR PROGRAM PROJECT







REQUIREMENTS

Need data on HAPs for refinery streams and products for emission estimates

PROBLEM

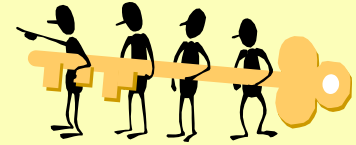
Intended final use of most refinery intermediates and products are performance based, not compound specific

- Not much data available for any single refinery or company**





APPROACH



Multicompany endeavor to share refinery stream composition data for HAPs in order to improve the quality of emission estimating using **existing analytical data**

SELECTION OF HAPS

CAA-A lists 189 species as Hazardous Air Pollutants
...but only a few are present in petroleum and its products

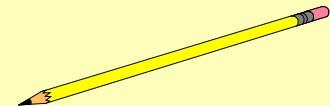
Listed
HAPs

- ◀ 1,3 Butadiene
- ◀ Benzene
- ◀ Biphenyl
- ◀ Cresols
- ◀ Cumene
- ◀ Ethylbenzene
- ◀ Ethylene Glycol
- ◀ n-Hexane
- ◀ Methanol
- ◀ Methyl Ethyl Ketone
- ◀ Methyl-tert-Butyether
- ◀ Naphthalene
- ◀ Phenol
- ◀ Styrene
- ◀ 1,2,4-Trimethylbenzene
- ◀ 2,2,4-Trimethylpentane
- ◀ Toluene
- ◀ Xylenes

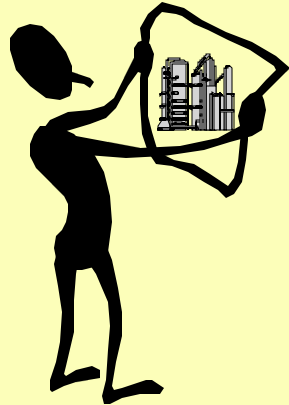


Accidental
Releases

- ◀ Ethane
- ◀ Ethylene
- ◀ Propane
- ◀ Propylene
- ◀ Butane
- ◀ Hydrogen Sulfide



PROCESS UNITS - NUMBER OF STREAMS



- ▶ Atmospheric Distillation - 6
- ▶ Vacuum Distillation - 3
- ▶ Asphalt Plant - 2
- ▶ Visbreaker - 1
- ▶ Resid Hydroprocess - 1
- ▶ Coker - 3
- ▶ Polymerization - 3
- ▶ Cat Hydrocraker - 3
- ▶ Cat Hydrotreater - 1
- ▶ Cat. Craker - 2
- ▶ Cracked Gas Plant - 4
- ▶ Sats Gas Plant - 1
- ▶ Hydrodesulfurization - 4
- ▶ Alkylation - 3
- ▶ Cat Reformer - 2
- ▶ Cat. Isomerization - 2
- ▶ Caustic Treating - 1
- ▶ Sulfur Plant - 1
- ▶ Sour Water Stripper - 1
- ▶ Amine Treating - 2
- ▶ Naphtha Pretreat - 1
- ▶ Aromatics extract - 4
- ▶ Various Units - 1

REFINED PRODUCTS

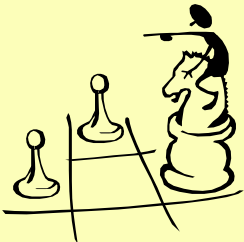
- ▶ Distillate Blending
- ▶ Gasoline Blending
- ▶ Kerosene Treating

HYDROCARBON STREAM NAMING CONVENTION

CRUDE OIL FRACTIONS FROM DISTILLATION

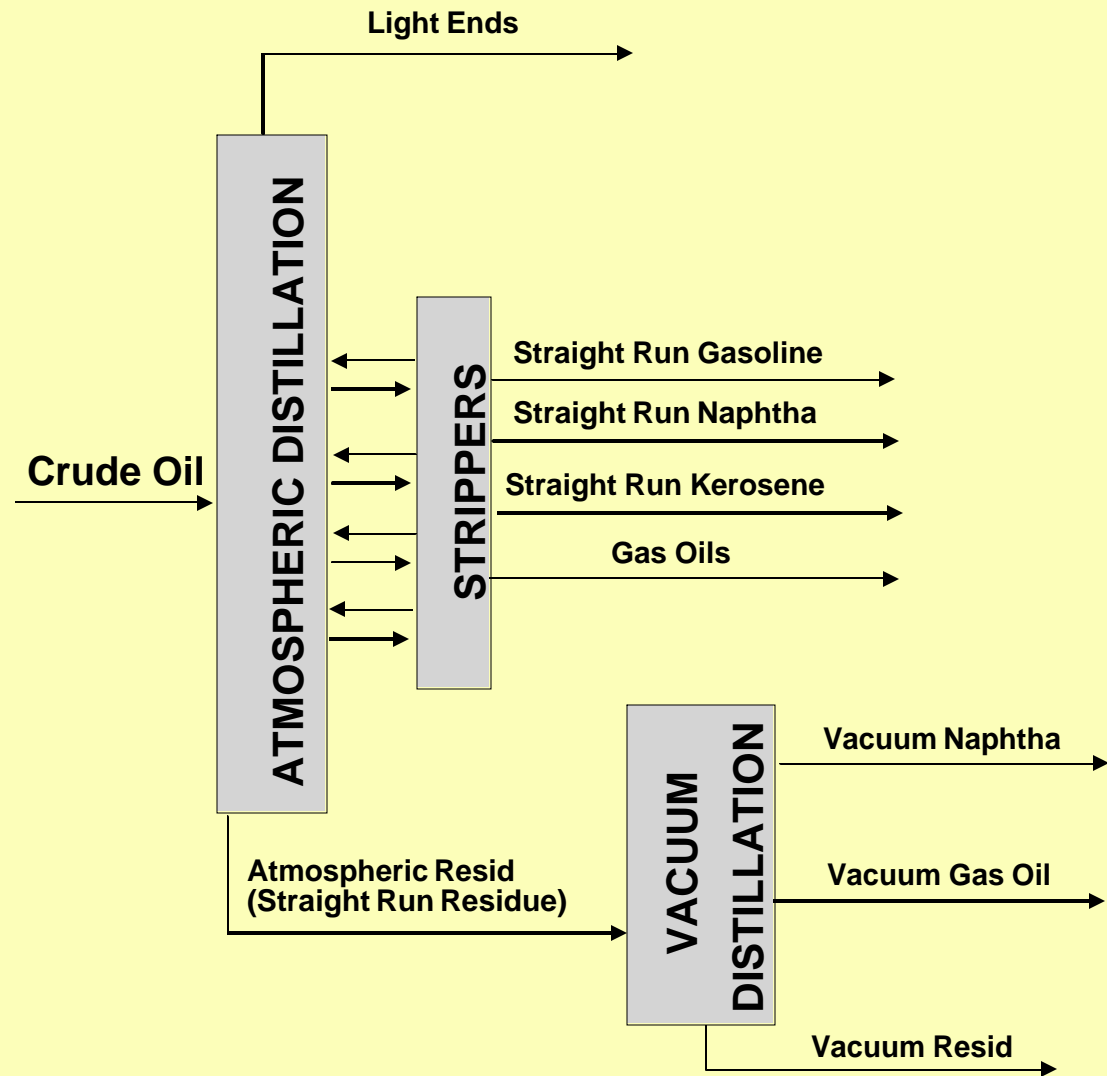
SR: Straight Run

	EXAMPLES OF STREAM NAME	APPROXIMATE BOILING RANGE, F	APPROXIMATE CARBON NUMBER	POSSIBLE DISPOSITIONS
Light Ends	Off Gas		1-3	To Sats Gas Plant
	SR Butane		4	To Butane Splitter
	SR Gasoline	70-130	5-6	To OP or Isomerization
	SR Light Naphtha	120-220	6-7	To Reformer/Aromatics Extraction
	SR Heavy Naphtha	200-400	7-11	To Reformer/Treat & Blend
	Kerosene	350-500	11-14	Jet Fuel via DHT
	SR Light Gas Oil	450-650	14-20	Diesel/Furnace Oil via DHT
Heavy Ends	SR Heavy Gas Oil	600-800	20-25	To Conversion Units
	SR Resid			
	Atmos. Resid	800+	25+	To Vacuum Flasher
	Long Resid			
	Flashed Distillate	800-1050	25-35	To Conversion Units
	Pitch			
	Vacuum Residue	1000+	35+	To Asphalt, Residual Fuel, Cokers, Resid Conversion
	Short Resid			





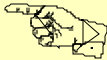
This nomenclature applies to streams from all units. The example here is for fractions from crude distillation. However, streams from other units with corresponding carbon and boiling temperature ranges are named using the same general system. For example, if from Catalytic Cracking, then CC Light Naphtha, CC Heavy Gas Oil, etc. If only one naphtha, then Full Range CC Naphtha, Full Range SR Naphtha corresponding to C6 to C11 range.

ATMOSPHERIC & VACUUM DISTILLATIONS





DATA AVAILABLE

- Relative abundance of data of some HAPs for light streams 
- Limited data for streams heavier than gasoline 
- Difficult to assign data to “right” stream group 



RELATIVE ABUNDANCE OF DATA

Here I use one of Ken's plots of a light stream with many datapoints/several HAPs

LIMITED AVAILABLE DATA

Here I use one of Ken's plots of a heavy stream with few datapoints/few HAPs



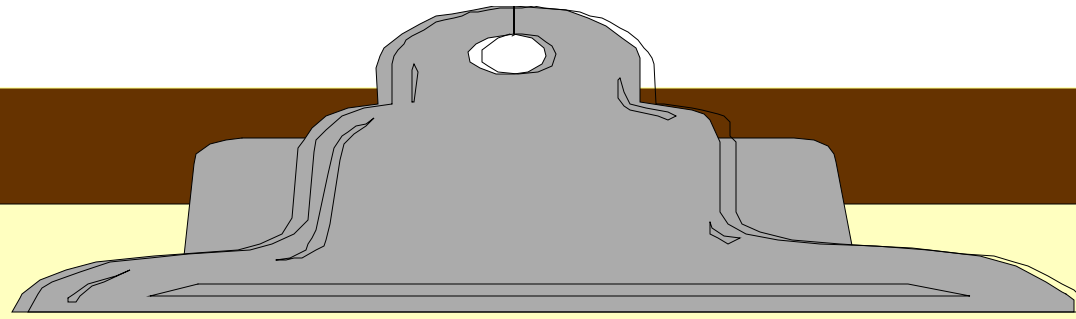
DATA LIMITATIONS

COMPLEXITY OF REFINERY OPERATIONS

- Variability in crude oil composition
- Operational variabilities
- Diversity of process units
- Stream naming/definition inconsistencies

**NO "RIGHT" SPECIATION OF
INTERMEDIATE REFINERY
STREAMS OR PRODUCTS**

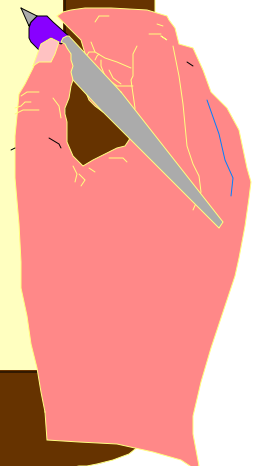
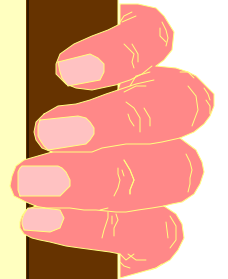




WORK PRODUCT

Data collected represents...

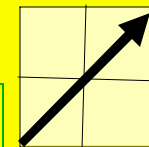
- ▶ 20+ processing and treating units
- ▶ 52 process streams
- ▶ 18 HAPs
- ▶ 6 accidental release compounds
- ▶ 31 US refineries
- ▶ 8 Oil companies
- ▶ 1000+ stream samples
- ▶ 6000+ analytical measurements
- EXCEL SPREADSHEET



IMMEDIATE PAYOFF

APPLICATION FOR THROUGHPUT INCREASE

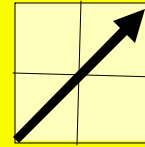
- ▶ **Developed speciation database for air permit**
19 streams → 1.8 billion gallons of gasoline
 - Pertinent data tabulated in 2 days
 - Analytical costs savings of \$100,000+
 - Saved 3-6 months - time that would have been required to develop database
- ▶ **Accurate speciation of multiple intermediate streams critical for successful permit**
- ▶ **Permit obtained within 2 months!!!**



This business opportunity has expected revenues of \$4MM/year starting Feb 1996



LONGER TERM PAYOFF INFLUENCING REGULATIONS



- ▶ Results from the database have been used in several industry leg/reg applications with longer term payoffs expected
 - ▶ Gasoline distribution MACT comments
 - ▶ Refinery MACT negotiations
 - ▶ Definition of intermediate streams for MACT applicability
 - ▶ Emissions speciation estimates for Title V compliance

