Detailed Operational Data as a Means to Improve Air Emissions Management

Angela Martins, Rodrigo Chavez, Vicente Schmall

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Kenneth Weiss, Braulio Pikman

Air Energy and Climate Change, Environmental Resources Management (ERM),

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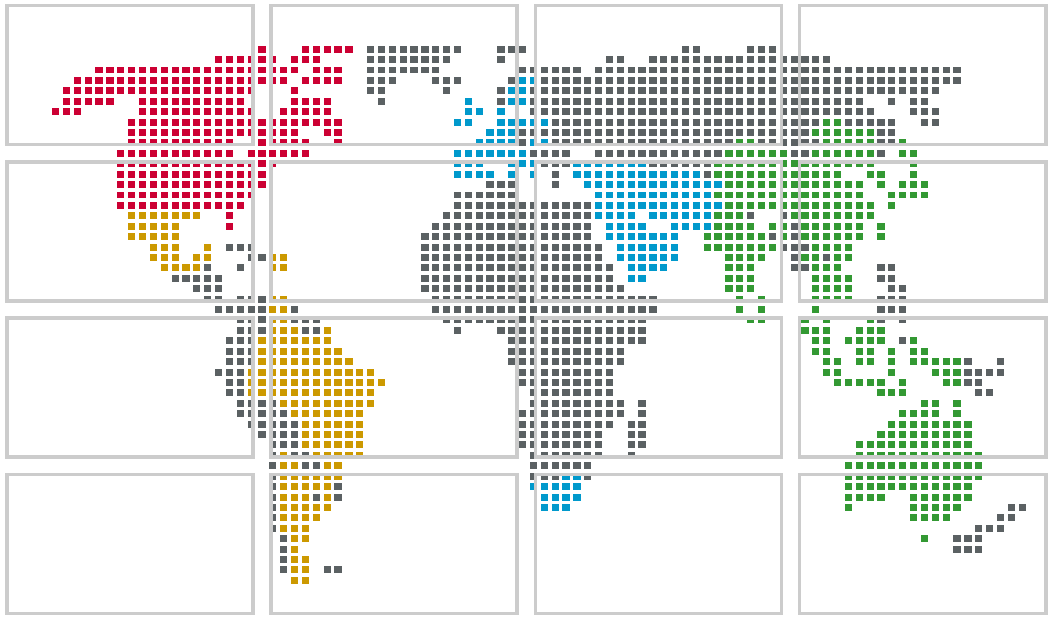

3,200 staff in 135 offices in 40 countries

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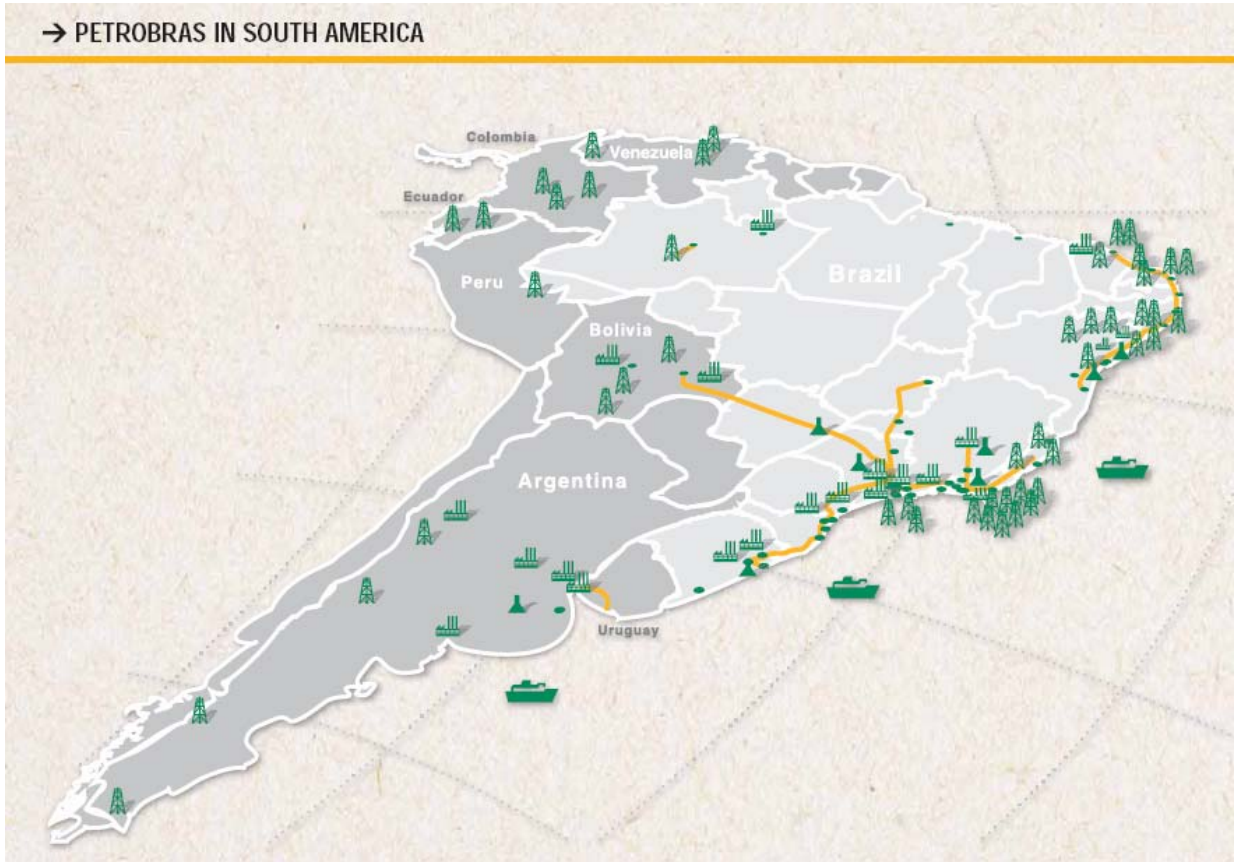
Petrobras is an integrated Oil & Gas Company operating in Americas and Africa

Producing and refining 2,000,000 b.p.d.



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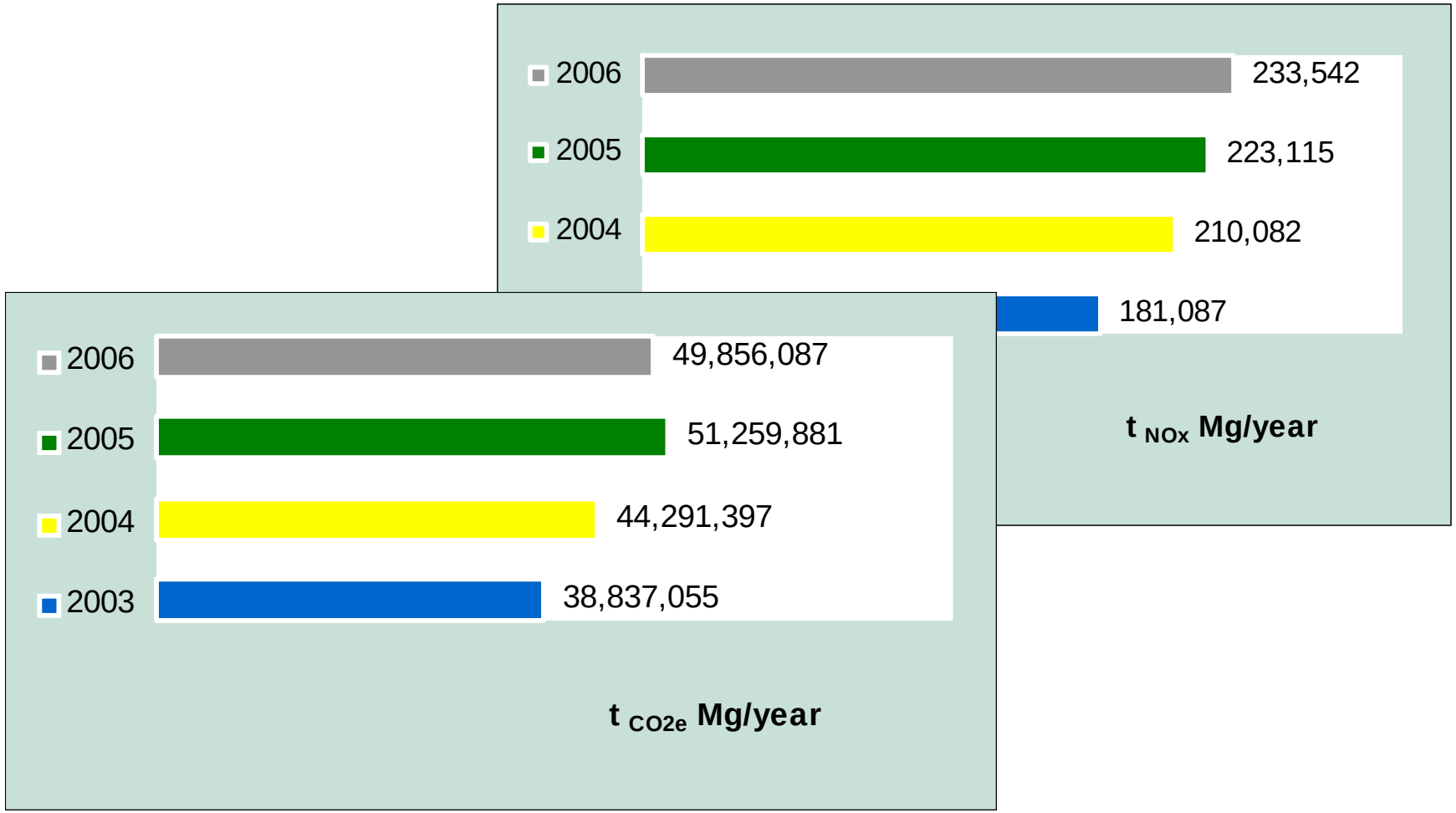
Petrobras Emissions: CO_2, CH_4, N_2O, CO, SO_2, PM, NO_x, NMHC



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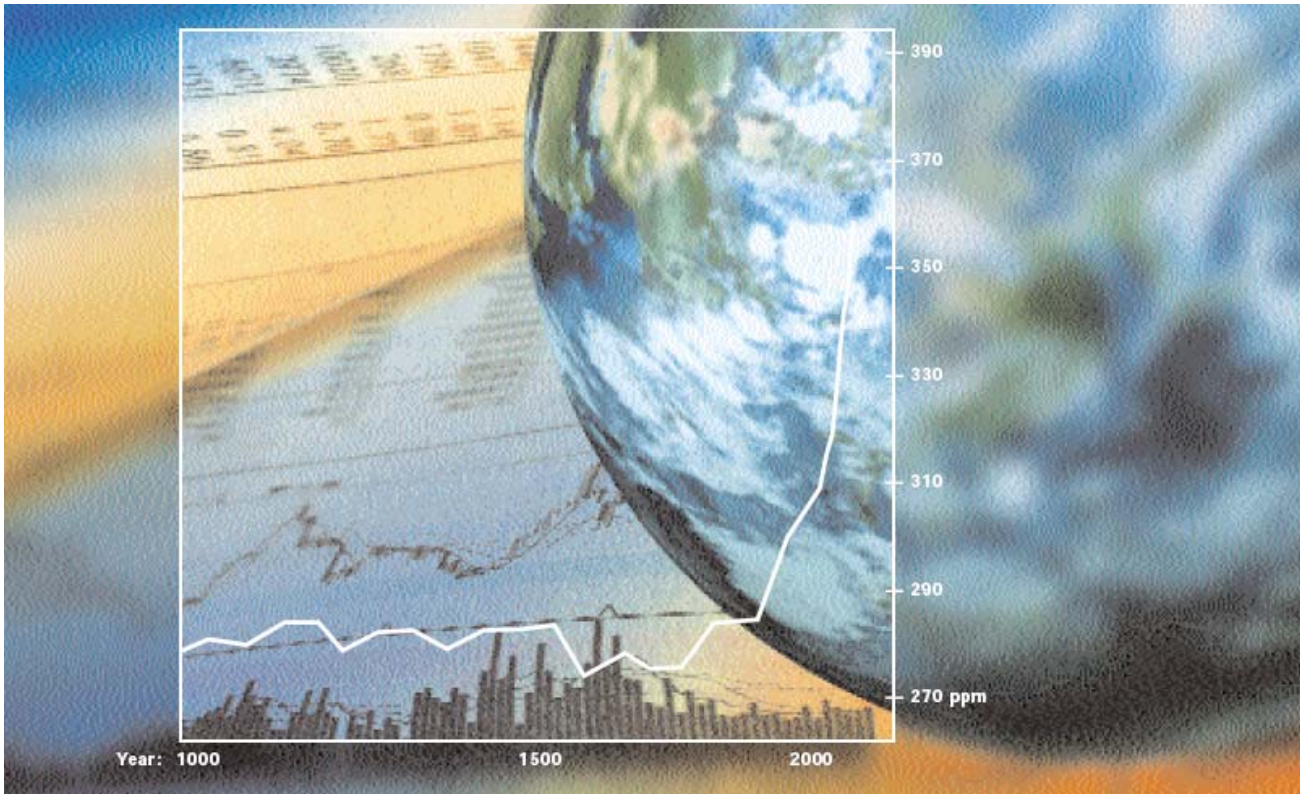
Bottom up air emissions inventory -

Metrics to track and improve environmental performance



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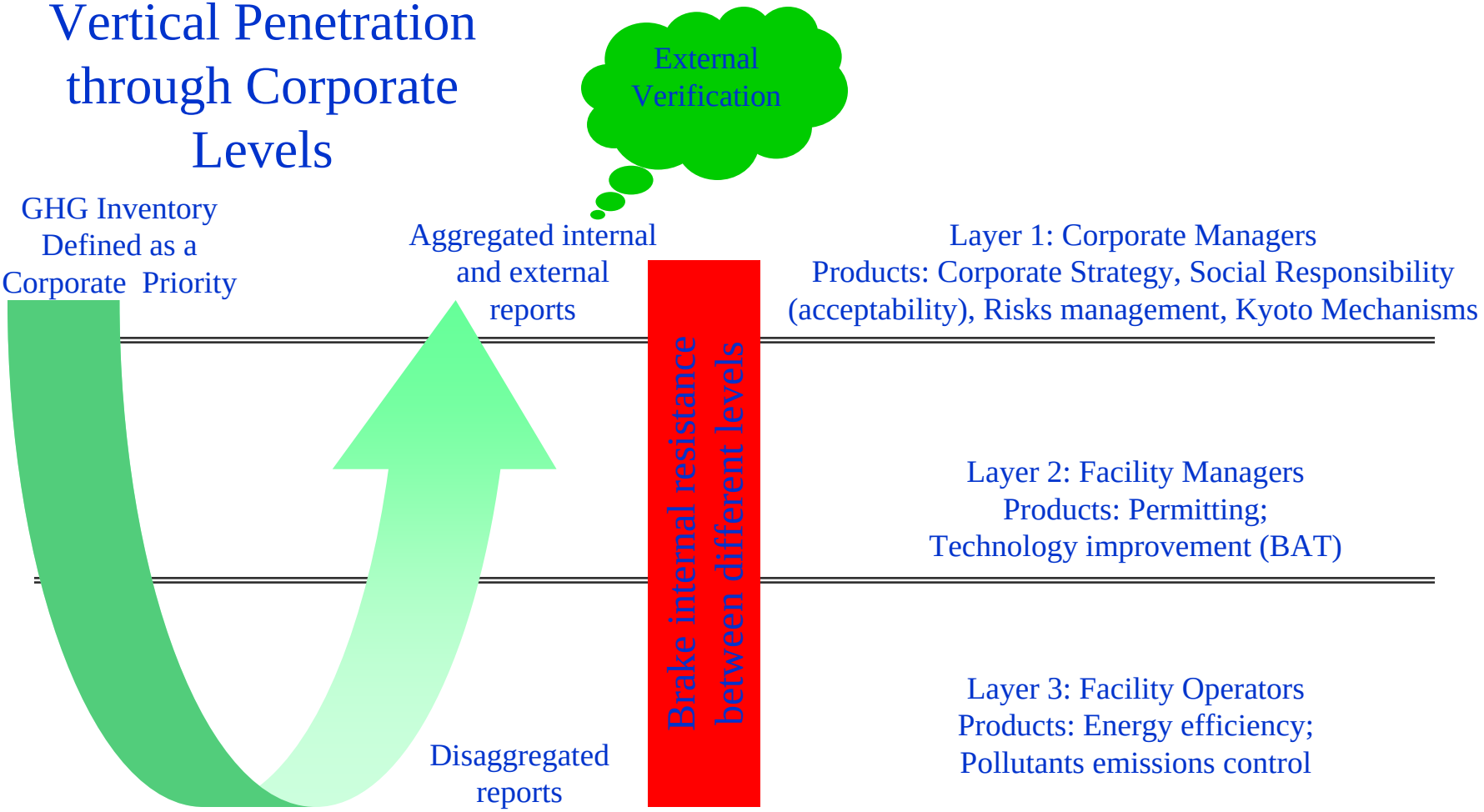
Bottom-up Air Emissions Inventories

Vertical Penetration through Corporate Levels



Inventory Implementation, incorporates criteria pollutants and is based on operational data per emission source (Bottom-up)

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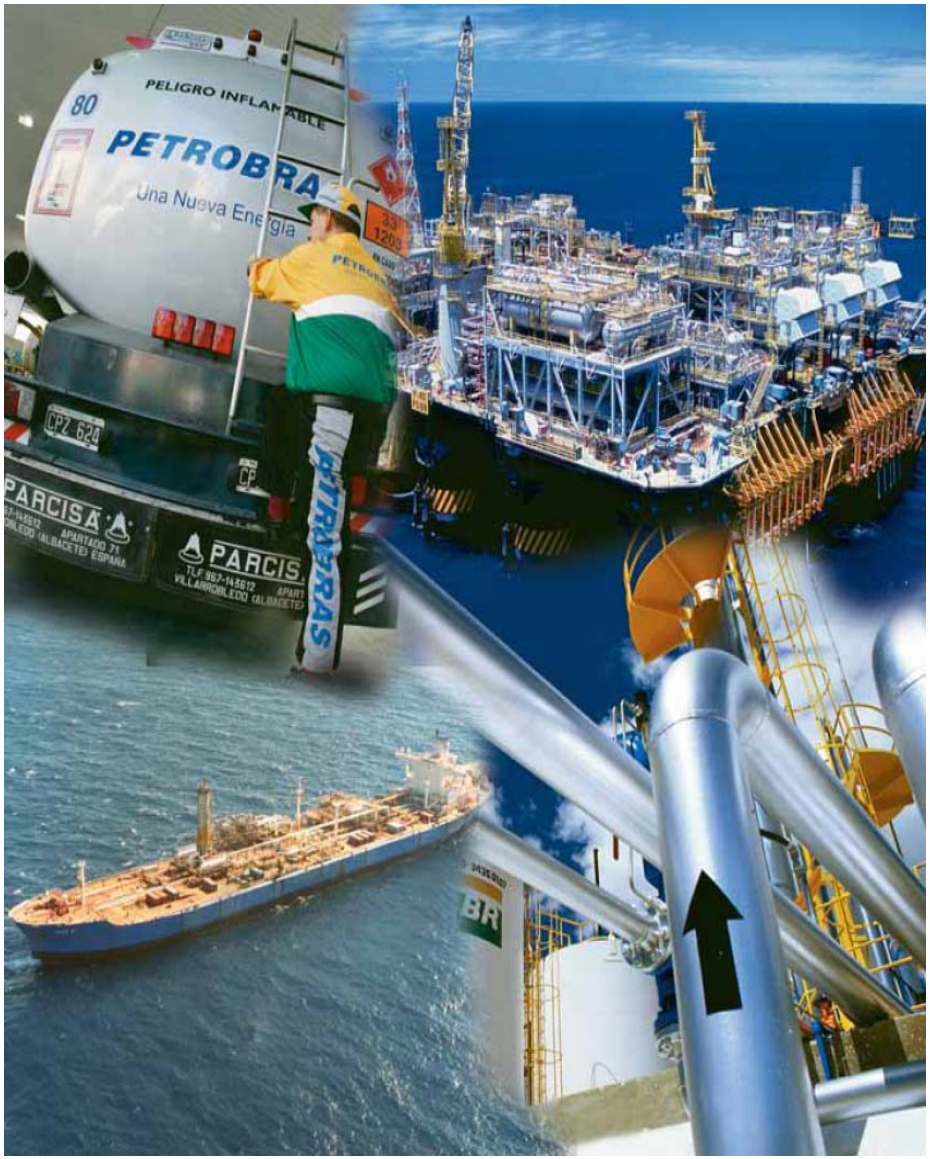

Bottom-up Air Emissions Inventory Systems

Air Emission Inventory – The first step to energy and emissions management

- ***Air Emissions Inventory Systems should:***

- ***Be based on operational disaggregated data and provide results that are consistent with monitored parameters***

- ***Allow carbon emissions control emphasizing actions regarding energy conservation***

- ***Allow new scenarios simulations, helping managers choice of the Corporate best options considering Trading regime***

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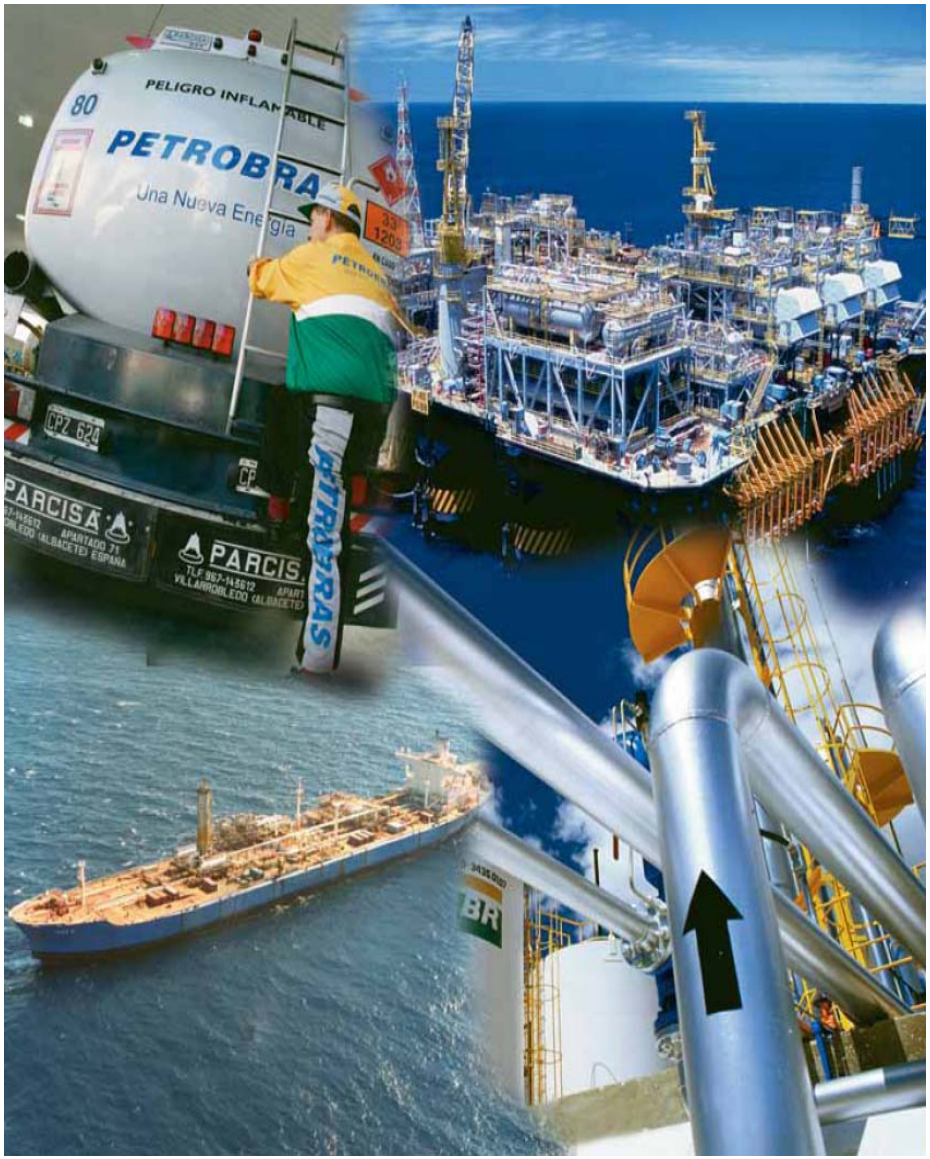

Bottom-up Air Emissions Inventory Systems

Air Emission Inventory – The first step to energy and emissions management

Air Emissions Inventory Systems should:

- ***Be WEB based; no need to install any component in all computers (i.e. like internet banking)***
- ***Assure security of information allowing for different levels of access***
- ***Be able to aggregate and disaggregate information in all possible ways***

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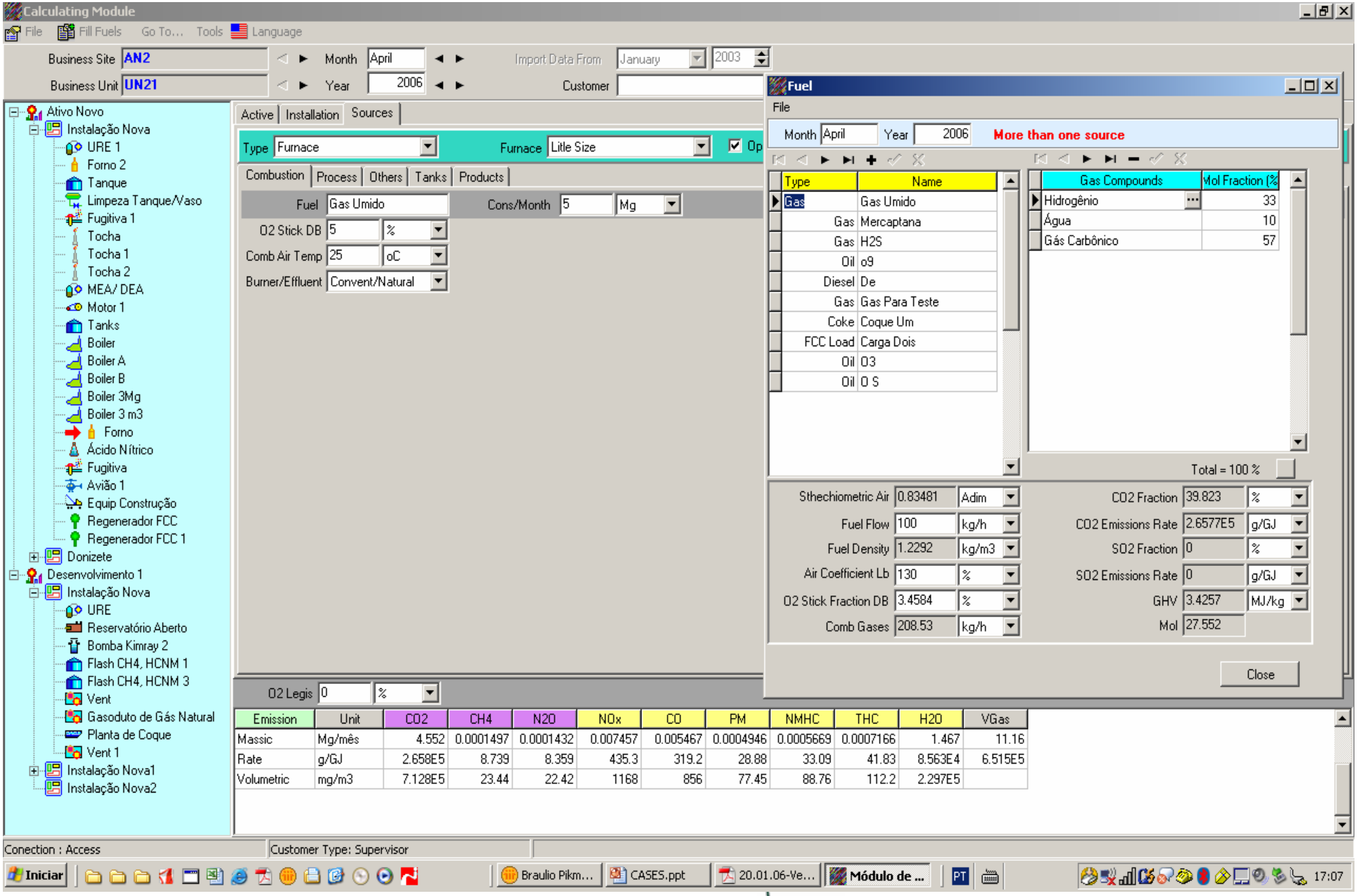

Calculation module screen

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Example: Combustion Calculation

There is only one method to calculate emissions. Petrobras decided to adopt material balances (CO_2, SO_2) and emission factors associated to fuel mass flow as the only method to determine emissions

1. **Select a fuel and its properties either from a default list or from a specific analysis**
2. **Provide the operational parameters including fuel flow, air temperature, oxygen content of flue gases, type of burner and type of draft**
3. **Missing operational information should be replaced automatically by default data based on Petrobras experience**

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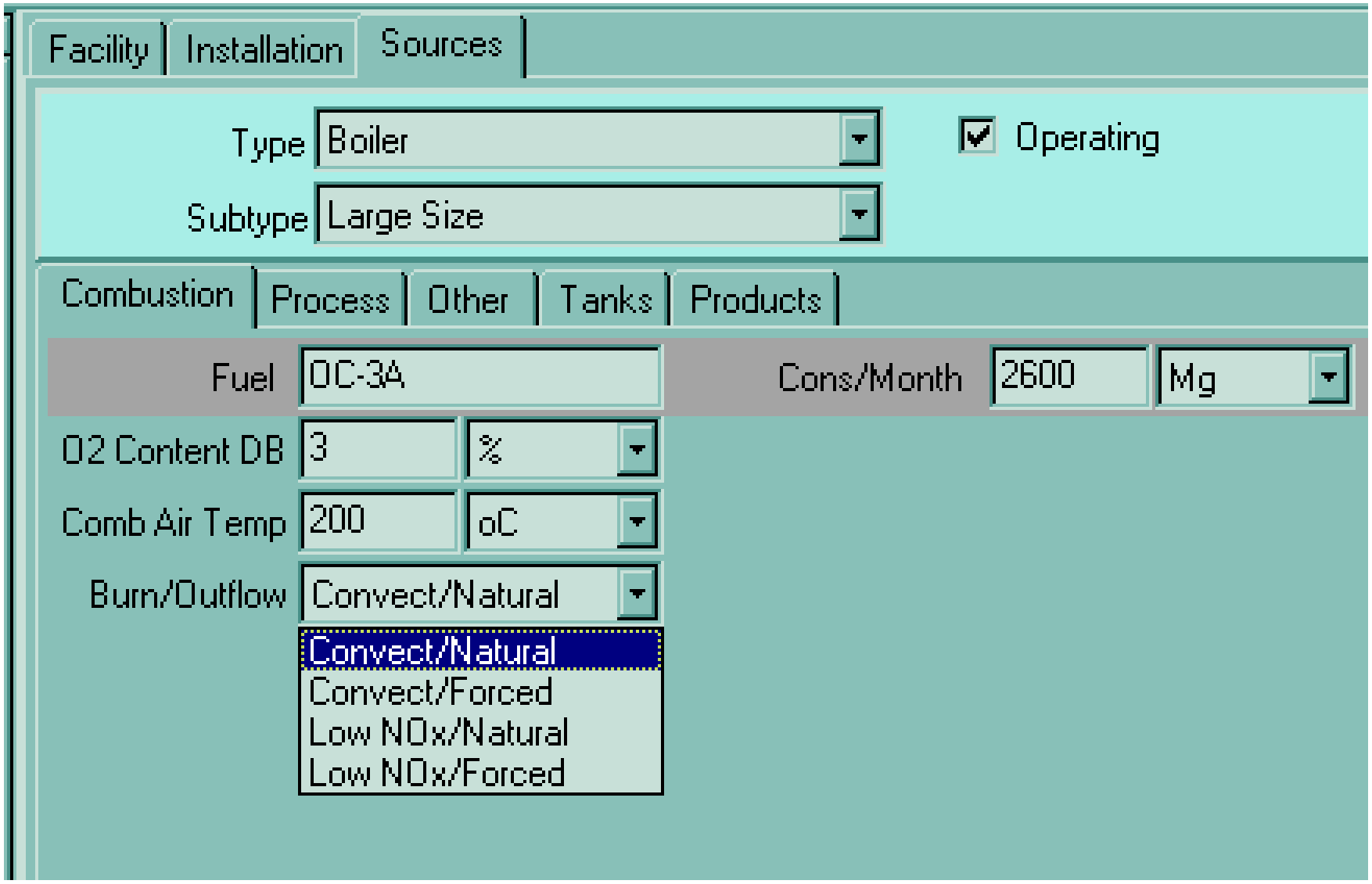

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O2 Legis 0 %

Emission	Unit	CO2	CH4	N2O	NOx	CO	PM	NMHC	THC	H2O	VGas
Massic	Mg/mês	4.552	0.0001497	0.0001432	0.007457	0.005467	0.0004946	0.0005669	0.0007166	1.467	11.16
Rate	g/GJ	2.658E5	8.739	8.359	435.3	319.2	28.88	33.09	41.83	8.563E4	6.515E5
Volumetric	mg/m3	7.128E5	23.44	22.42	1168	856	77.45	88.76	112.2	2.297E5	

- **Some of the emissions are influenced by each operational parameter (e.g. NO_x).**
- **CO_2 and SO_2 are calculated based on material balances.**
- **Fuel composition plus oxygen content of flue gases allow for exhausted gases mass flow rate calculation**
- **Concentration from monitoring devices (e.g. CO ppmv) is usable as source of information for mass flow calculation for a specific gas**

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Example: NO_x emissions from Combustion – basic EF from AP42

- NO_x correction factor applied as a function of temperature, air excess, type of burner, type of draft
- NO_x emissions were monitored in an experimental test conducted with typical Petrobras burners in a series of trial tests run at the Petrobras Research Laboratory.
- These tests were accompanied by Refinery engineers to ensure operational conditions were being reproduced at the Laboratory.

Fuel: **Oil**

Cold Furnace (<700 C)

		TEMERATURE				
		-15	**15**	**30**	**240**	**300**
Convenmtional burner /Natural draft	Air excess < 20%	0.93	1	1	1.15	1.3
	Air excess > 20%	0.96	1	1	1.2	1.35

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Example: Tanks

- **Petrobras engineers are assessing the influence of the many different accessories on tanks emissions in order to define a program to reduce their NMHC emissions.**
- **ERM introduced all equations from the EPA Tanks 4.09d with the ability to show emissions per accessory.**
- **Petrobras developed specific equations for vapor pressure of more than 100 of its products.**

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Example: FCCU

- **Fluid catalytic crackers are a major source of emission in refineries**
- **Petrobras developed a set of correlations for each of its 14 refineries in LAC in order to determine NO_x and SO_x emissions as a function of type of equipment, operational conditions and quality of the feedstock**

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More data means more workload to gather them

More data means more quality, accuracy and usefulness of results

IT technology must be used to reduce human effort not avoiding complexity when it means accuracy and providing results that allow for emissions management at all levels – operational to corporate

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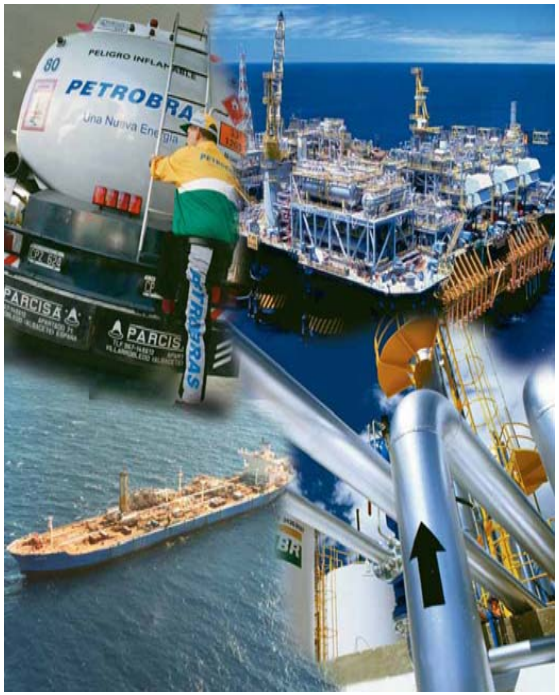
For more information



braulio.pikman@erm.com

rodrigochaves@petrobras.com.br