NARSTO Emission Inventory Workshop

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Development of the API Compendium for Estimating Greenhouse Gas Emissions

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Background

In response to continued interest by its member companies about consistency in greenhouse gas emissions estimation, the American Petroleum Institute (API) developed a *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* (API, 2001). Initially distributed in April 2001, the Compendium is a result of more than a year long effort by API to screen, evaluate and document a range of calculation techniques and emission factors that could be useful for developing greenhouse gas emissions inventories.

Introduction

In developing the Compendium, API reached out to sibling organizations and reviewed their guidance documents, along with emerging national and international protocols and internal company GHG estimation protocols. This paper provides a brief overview of the Compendium development and introduces the technical approach and techniques for estimating carbon dioxide (CO_2) and methane (CH_4) emissions. It also discusses the process undertaken to compare and reconcile different estimation methodologies used by other organizations.

Through this work, API is expanding the dialogue among the global oil and gas industry and pursuing consistency in GHG emissions estimation to ensure comparability and the eventual fungibility of emission reductions. Findings from the pilot phase distribution of the Compendium are addressed in this paper, as well as enhancements planned for the 2003 update of the document.

Overview of API Compendium

- **Issued in April 2001 for "road-testing" and "learning by doing"**
- **Main Attributes include:**
  - ✓ **Consistent, standardized methodologies**
  - ✓ **Compilation of recognized estimation approaches**
  - ✓ **Focussed on carbon dioxide (CO_2) and methane (CH_4) emissions**
  - ✓ **Combustion sources have broad industry application**
  - ✓ **Non-combustion sources specific to oil and natural gas industry**
- **Revised Compendium available by end of 2003.**

Greenhouse Gas Emissions Methodology Project

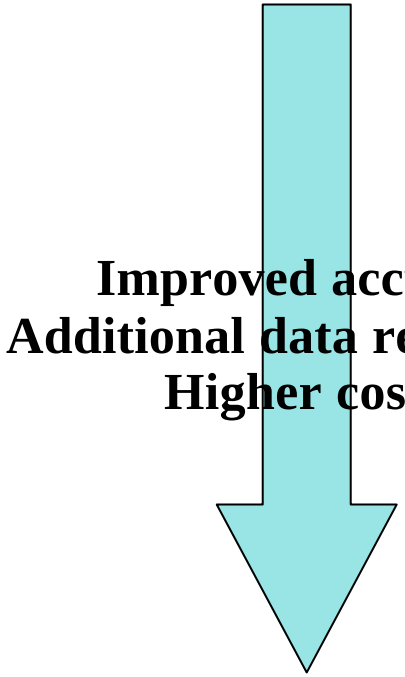
- **Objectives –**
  - ✓ **Provide technical expertise on current methodologies and investigate improvements and streamlining options**
  - ✓ **Promote dissemination of consistent guidance for estimation of petroleum companies GHG emissions**
- **Mandate –**
  - ✓ **Focus on Industry Sources and Emissions**
  - ✓ **Concentrate mainly on CO_2 and CH_4**
- **Structure –**
  - ✓ **Multi-sector petroleum industry participation to ensure coordinated industry effort**

Methodology Approach

- **Emission sources**
  - ✓ **By source category**
    - **Combustion emissions**
    - **Process emissions**
    - **Fugitive emissions**
  - ✓ **By industry segment**
    - **Exploration and Production**
    - **Transportation and Distribution**
    - **Refining**
- **Preferred vs. alternative methods -**
  - ✓ **Decision trees to guide method selection**
  - ✓ **Sample calculations and Case Studies**
- **Data assumptions –**
  - ✓ **Standard gas conditions**
  - ✓ **SI units and units common to US practices**
  - ✓ **Unit conversion factors**

Typical Methods Hierarchy

Types of Approaches	Hierarchy
Published emission factors	
Equipment manufacturer emission factors	
Engineering calculations	
Monitoring over a range of conditions and deriving emission factors	
Periodic monitoring of emissions or parameters for calculating emissions	
Continuous emission monitoring	



Improved accuracy
Additional data requirements
Higher cost

General Findings

- CO_2 sources easier to generalize based on fuel carbon content and other properties -
  - ✓ Uncertainty range of 5-15% if estimate is based on heating values rather than carbon content
  - ✓ Additional errors may be introduced in fuel volumes data and in definitions of standard conditions
- CH_4 estimates more complex -
  - ✓ Device specific and can vary with operating practices
  - ✓ Requires knowledge of specific emission sources
- Techniques presented have broader application to many other industries
  - ✓ Particularly for combustion emissions

Consistency and Comparability in Emission Estimates

Need for Consistency -

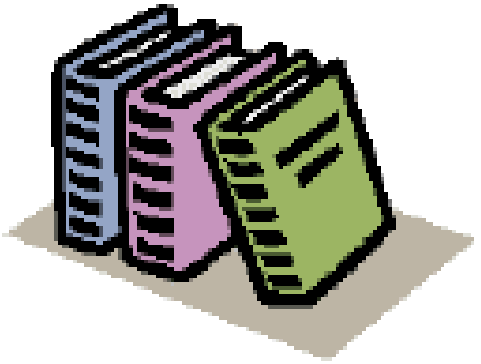
- ✓ Data aggregation,
- ✓ Performance evaluation, and
- ✓ Identification of trends

Elements of Comparability -

- ✓ Estimation approaches,
- ✓ Organizational boundaries,
- ✓ Emission sources included, and
- ✓ Data presentation and report approach

GHG Protocols Included in Quantitative Comparison

- Australian Petroleum Production and Exploration Association Greenhouse Challenge Report (APPEA, 2000)
- Canadian Association of Petroleum Producers, Global Climate Change Voluntary Challenge Guide (CAPP, 2000)
- Canadian Industrial Energy End-Use Data and Analysis Centre, “Guide for the Consumption of Energy Survey” (CIEEDAC, 2000)
- Environmental Protection Agency (EPA) Emission Inventory Improvement Program (EIIP, 1999)

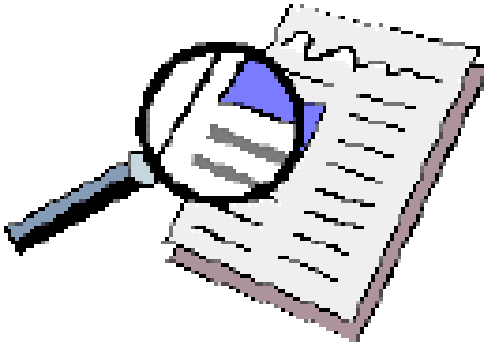


GHG Protocols Included in Quantitative Comparison

- **Exploration and Production Forum, Methods for Estimating Atmospheric Emissions from E&P Operations (E&P Forum, 1994)**
- **Intergovernmental Panel on Climate Change, Guidelines for National Greenhouse Gas Inventories (IPCC, 1997; UNECE/EMEP, 1999; IPCC, 2001)**
- **Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean, Atmospheric Emissions Inventories Methodologies in the Petroleum Industry (ARPEL, 1998)**
- **World Resources Institute and World Business Council for Sustainable Development, The Greenhouse Gas Protocol (WRI/WBCSD, 2001)**

Emission Factors Comparison

- **Qualitative comparison**
  - ✓ **Identify scope, emission sources, and application of emission factors**
  - ✓ **Determine root sources of the emission factors**
    - **Ensure that references are current**
  - ✓ **Ascertain transparency and documentation of derived emission factors**
- **Examine variability among**



Combustion Emission Factor Comparison

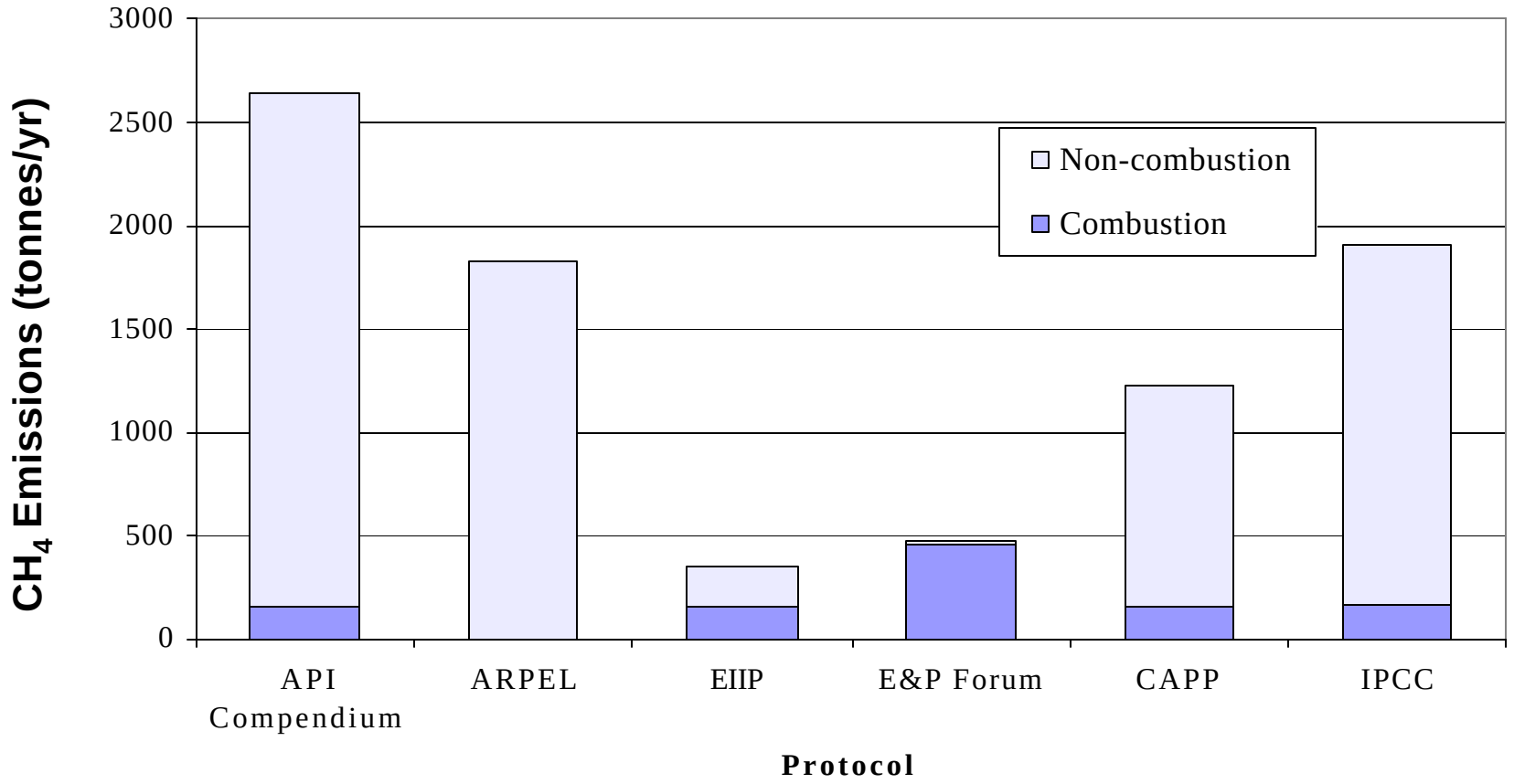
Tonnes CO_2/MMBTU (HHV)

Fuel Types	Compendium	AGO	IPCC	DEFRA	WRI/ WBCSD	CIEEDAC
Aviation Gas	0.0692	0.0717		0.0703	0.0693	
Bitumen	0.081	0.0851	0.0808	0.0879	0.0931	
Crude Oil	0.0743		0.0734	0.0703		
Distillate	0.0732	0.0718		0.0703	0.0732	0.0750
Diesel	0.0742	0.0735	0.0742	0.0732	0.0732	
Gasoline	0.0712		0.0694	0.0703	0.0710	
LPG	0.0629	0.0626	0.0632	0.0615	0.0631	
Natural Gas	0.0531	0.0542	0.0532	0.0556	0.0531	0.0520
Petroleum Coke	0.102	0.1260	0.1010	0.0879	0.1021	0.0987
Residual	0.0788	0.0718	0.0775	0.0703	0.0789	

Emission Factors Comparison

- **Quantitative comparison**
  - ✓ **6 hypothetical facilities provided in case studies in the Compendium**
    - **Onshore oil field with high CO_2 content**
    - **Offshore production platform**
    - **Production gathering compressor station**
    - **Natural gas processing facility**
    - **Marketing terminal**
    - **Refinery**
  - ✓ **Emissions were estimated using methodologies and/or emission factors from each protocol.**

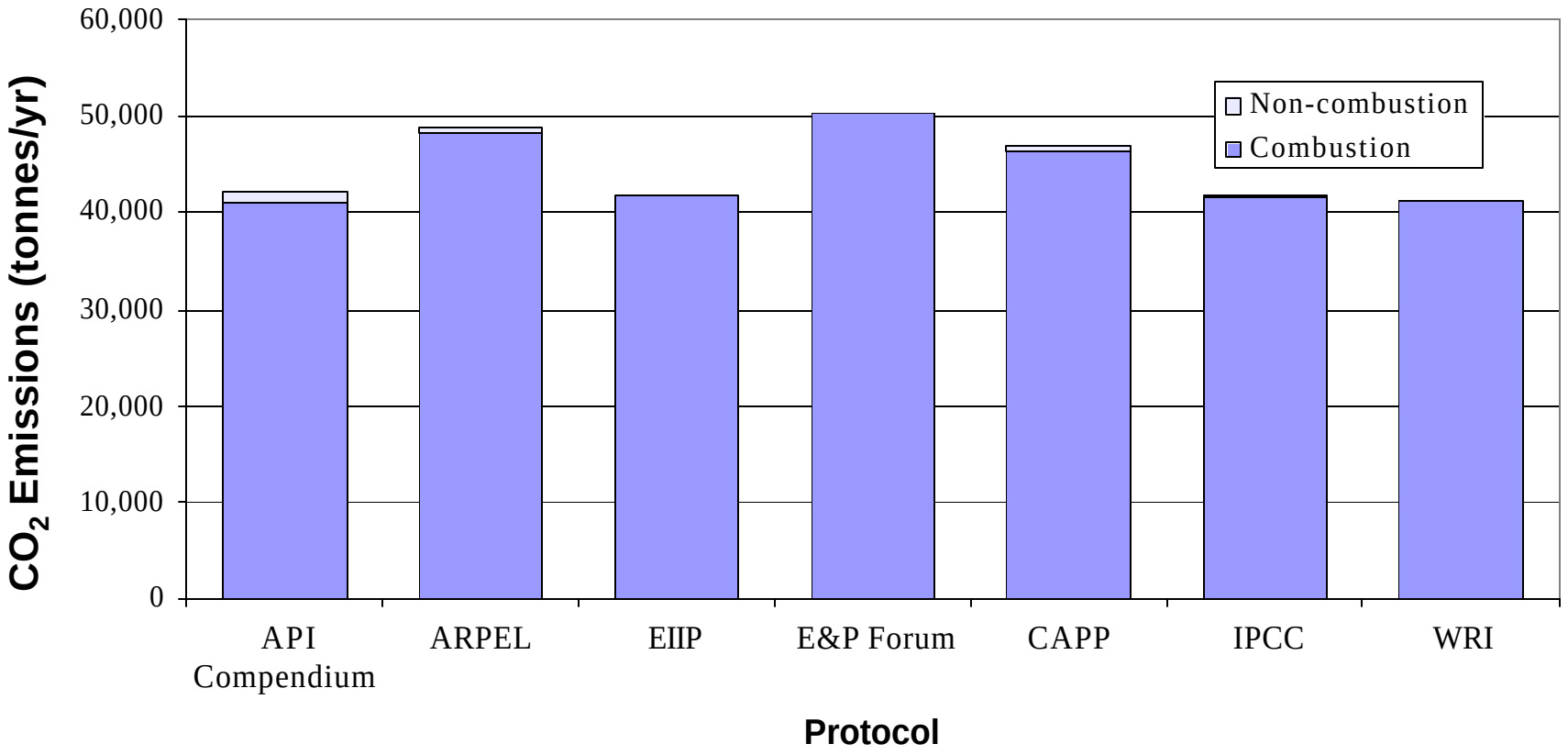
Comparative Emissions Estimate - Onshore Facility - CH4



Onshore Oil Production Facility

High CO_2 Content in Associated Gas

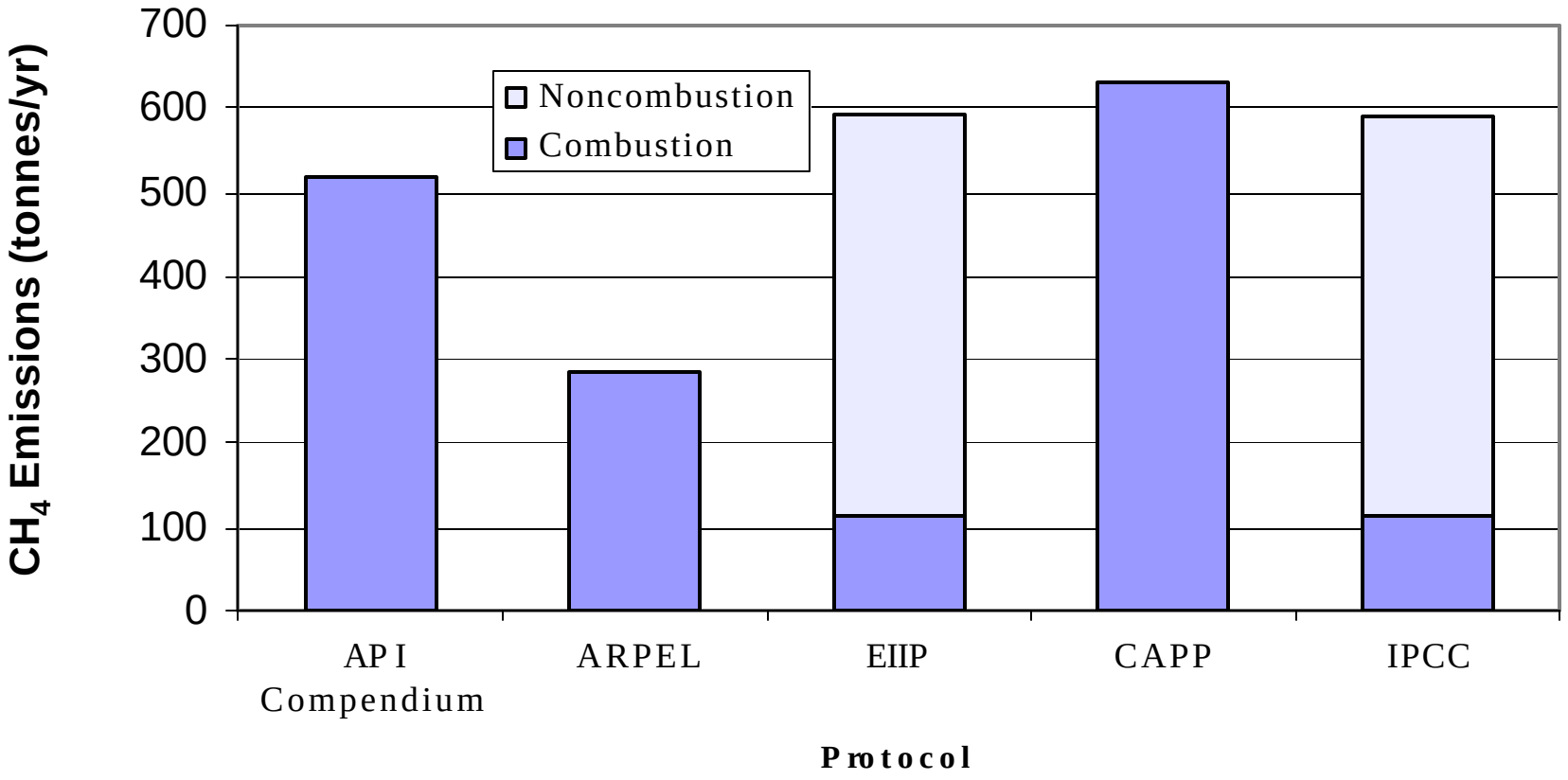
Comparative Emissions Estimate - Onshore Facility - CO2



Onshore Oil Production Facility

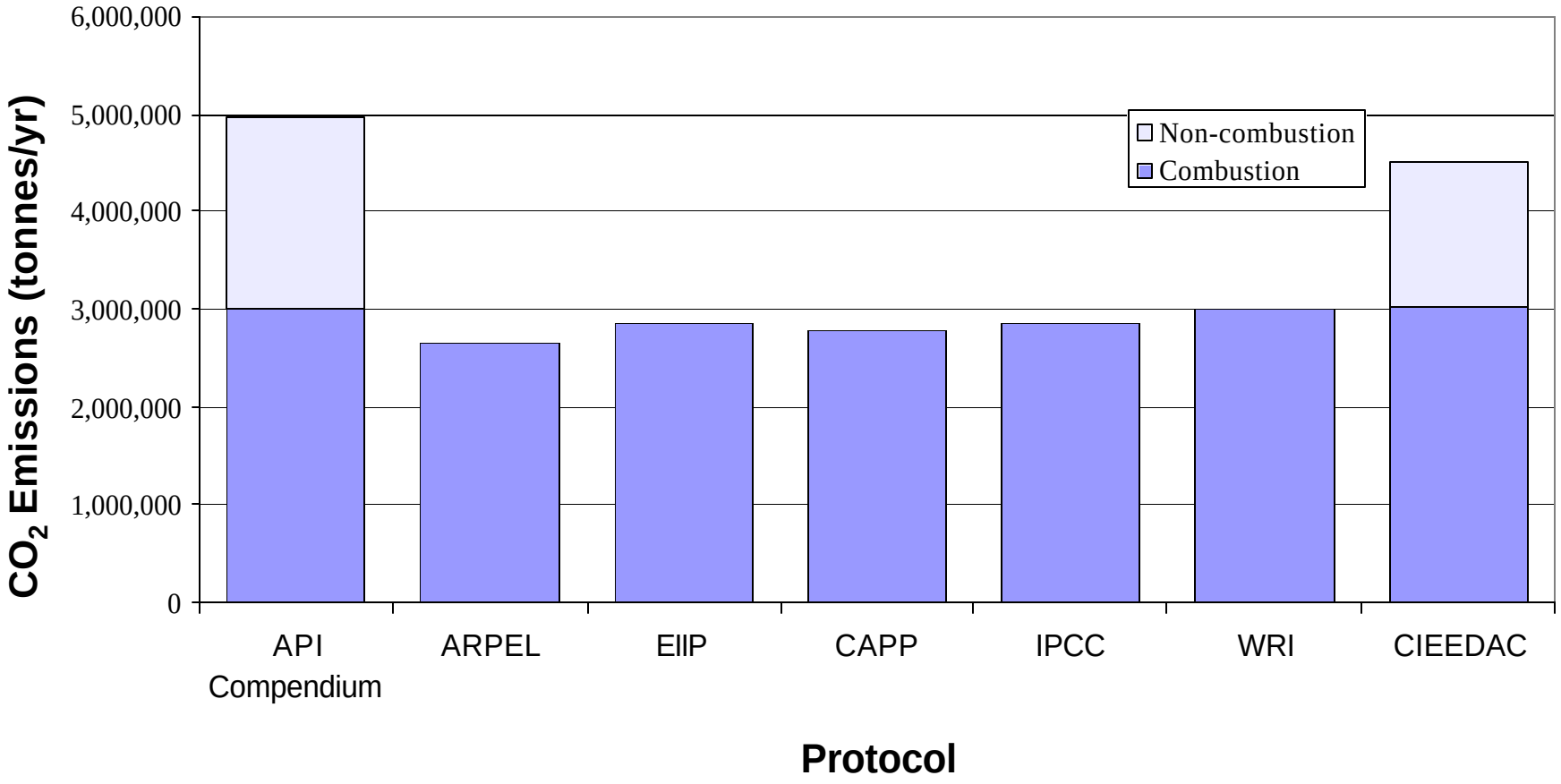
High CO_2 Content in Associated Gas

Comparative Emissions Estimate - Refinery - CH4



Large Complex Refinery

Comparative Emissions Estimate - Refinery - CO2



Large Complex Refinery

Key Findings from Emission Factors Comparison - Combustion

- **Variability of fuel-based factors due to different fuel specifications**
  - ✓ **For high quality results need fuel specific data (e.g. composition, heating value, density, etc.)**
- **Need to specify heating value convention**
- **Variation in CH4 emissions due to different versions of EPA's AP-42**
  - ✓ **Not significant for CO_2**

Key Findings from Emission Factors Comparison - Non-combustion

- **ARPEL quantified several sources not included in the Compendium**
- **Combining sources into one or two EFs makes it difficult to determine what sources are included**
- **Not all emission sources are addressed across protocols**

Comparison Synopsis Report, 2002

Outreach Efforts and Special Studies

- Dialogue among oil and gas associations worldwide
- Discussions with other protocols developers
- Protocols comparisons and emissions reduction studies
- New initiative for Global GHG Reporting Guidelines

Attaining global consistency will ensure national and regional comparability in estimation techniques and the eventual fungibility of emission reduction credits among those nations with comparable crediting or trading regimes.

Conclusions

- **Robust methods for calculating, reporting, and tracking emissions are essential for cost-effectively managing GHG emissions**
- **Consistent methodologies lend credibility to the estimates and enable aggregation and comparison**
- **Initial “road testing” of the API Compendium and special studies undertaken further support the pursuit of consistency**
- **These activities have spurred new initiatives to progress toward harmonization of methodologies and improved global compatibility emission estimates**