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Emission Inventories – Partnering for the Future
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Development of a Consistent Methodology for Estimating Greenhouse Gas Emissions from Oil and Gas Industry Operations

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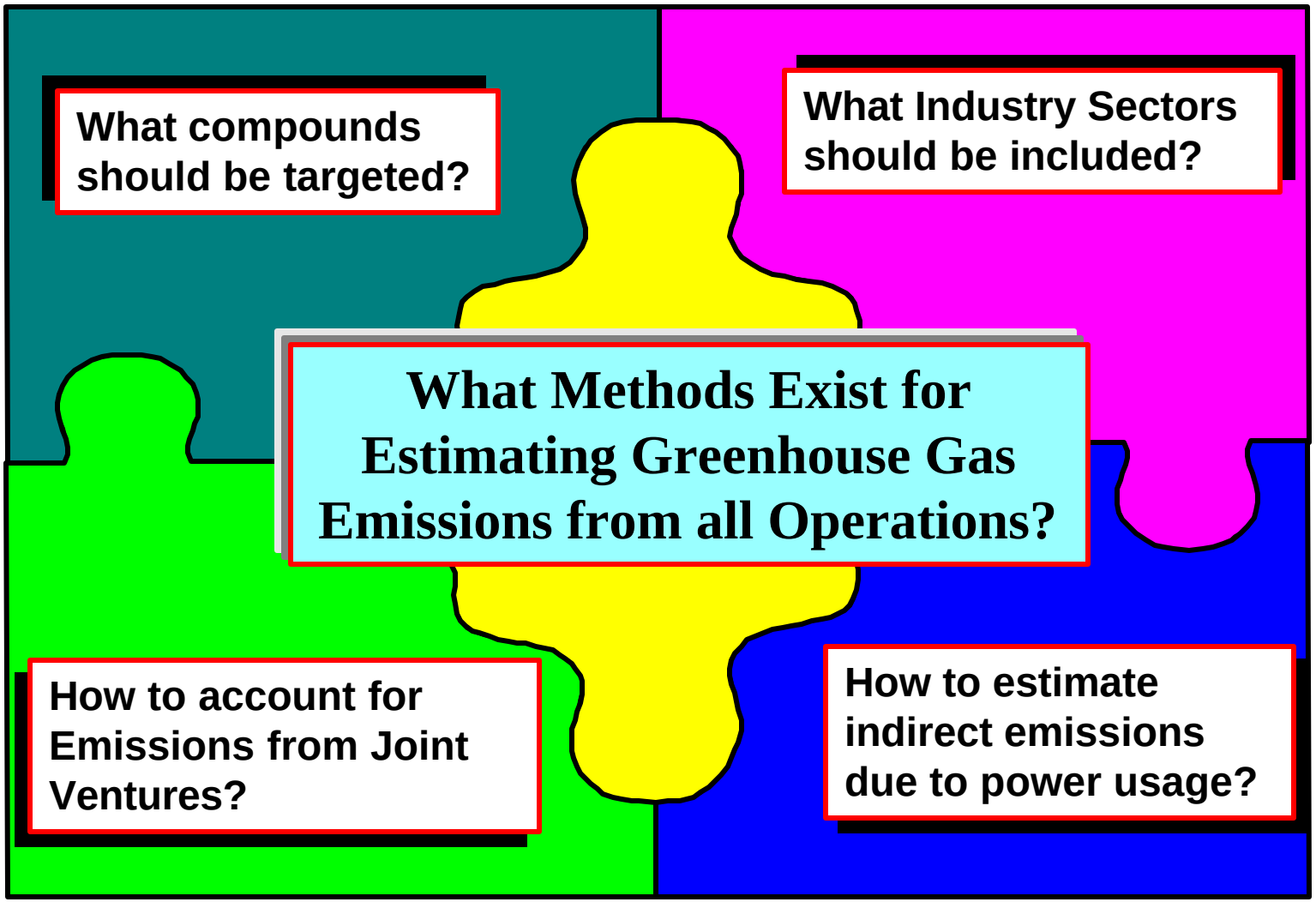
API Emissions Methodology WG

- **Objectives –**
  - **provide technical expertise on existing methodologies and ways to improve and streamline estimates**
  - **Promote consistent estimation of petroleum companies GHG emissions**
- **Structure - multi-sector expertise to ensure coordinated industry effort**
- **Many Member Companies active on WG**
  - **BP, ChevronTexaco, Conoco, Equilon, ExxonMobil, Marathon, Phillips and Shell**

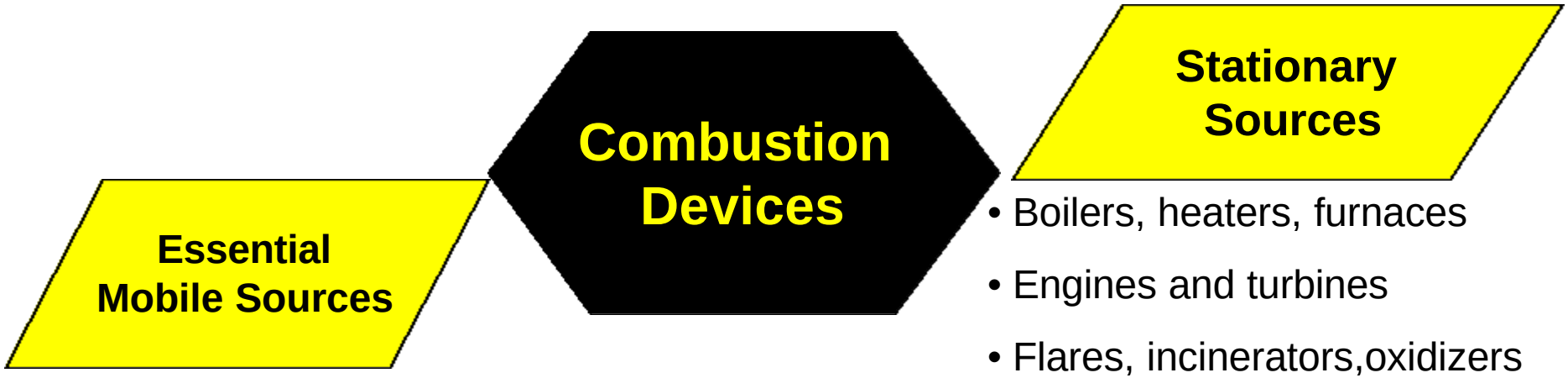
The Inventory Puzzle



Development Process

- **State of Knowledge -**
  - **Conducted initial comparison of members internal guidance**
  - **Augmented analysis by including government and international agency methodologies**
- **Compendium Structure –**
  - **Developed a device classification scheme**
  - **Adopted a consistent technical units system with appropriate conversion factors**
  - **Included detailed exhibits for step-by-step computations**

CO_2 and CH_4 Emission Sources - Combustion Devices



- Boilers, heaters, furnaces
- Engines and turbines
- Flares, incinerators,oxidizers

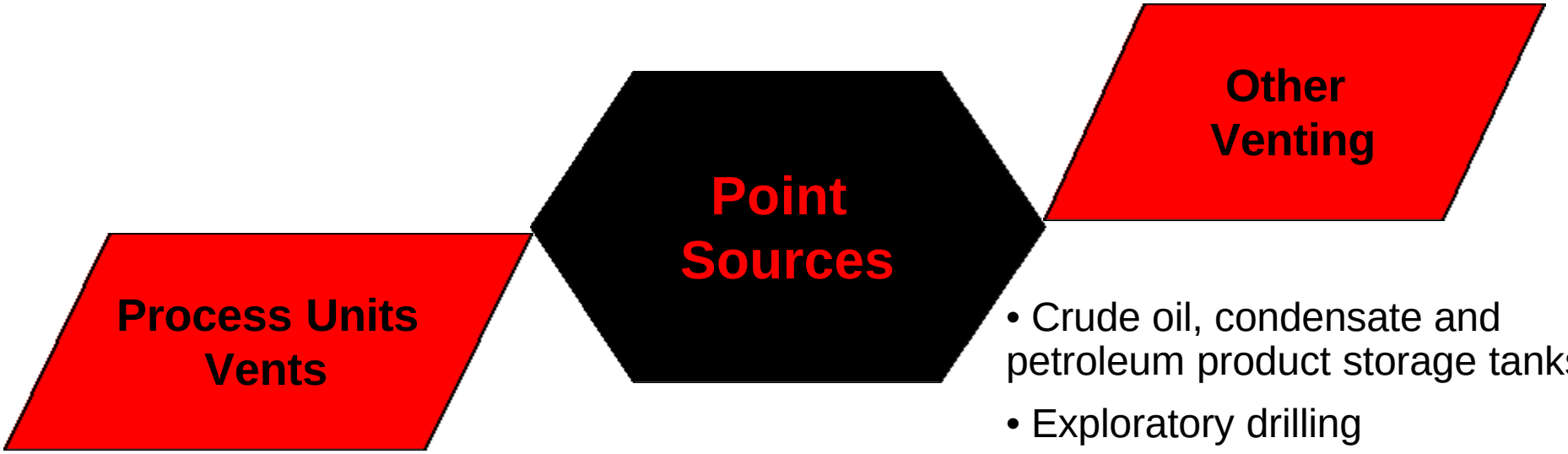
- Barges, ships, railcars
- Products distribution
- Personnel transport

Indirect Emissions

- Off-site electricity generation
- Steam import/export

Note: Treatment of Industrial Combustion and Indirect Emission is generic for most industrial and commercial applications

CO_2 and CH_4 Emission Sources - Non-Combustion Units

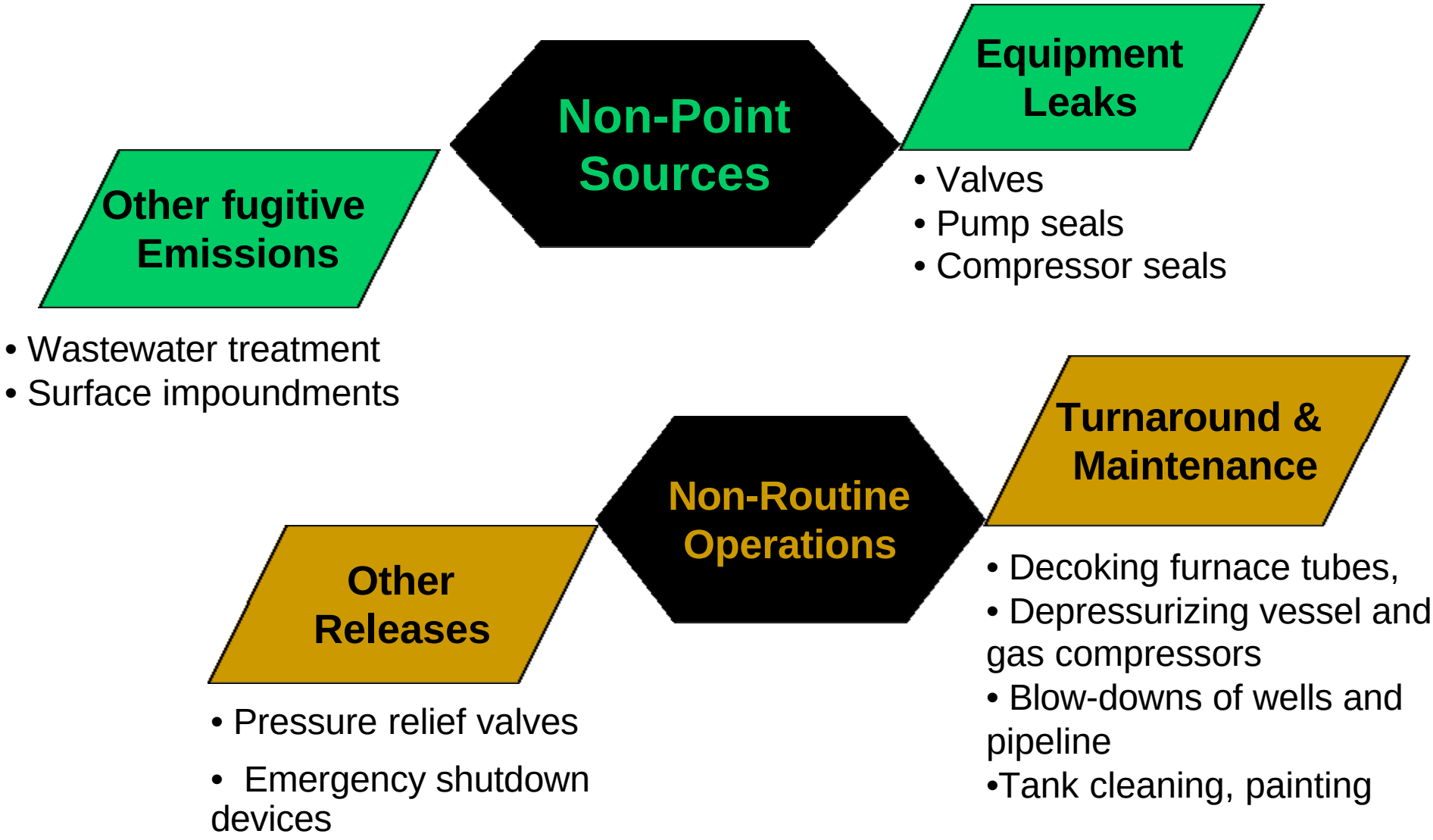


- Amine units
- Glycol dehydrators
- Refinery processes

- Crude oil, condensate and petroleum product storage tanks
- Exploratory drilling
- Ship and barge loading
- Product loading racks

Note: Treatment of non-combustion emissions linked to specialized industry processes and operations

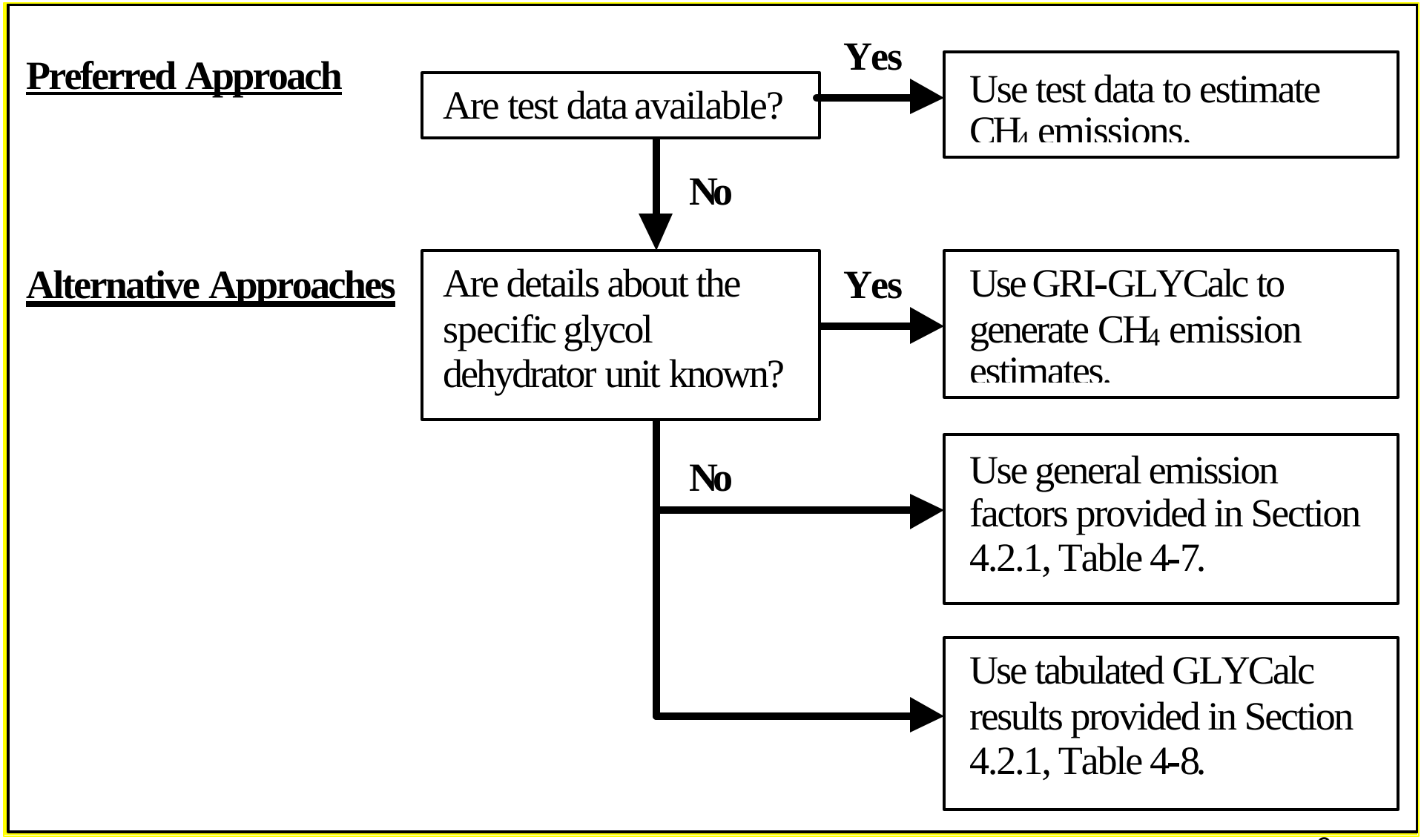
CO_2 and CH_4 Emission Sources - Various Industry Operations



Compendium Attributes

- Treatment of Industrial Combustion generic for most Industrial and Commercial combustion devices
- Other processes tailored to Oil & Gas Industry sources and operations
- Computational scope limited to CO_2 and CH_4
- Comprehensive compilation of existing factors
  - Combustion emissions suitable for all industries
  - Non-combustion emissions linked to specialized processes
- Decision trees used to help inventory developers maximize use of available data
- Case studies from across the petroleum industry used to demonstrate the computational approach

Example Decision Tree for Selecting CH_4 Estimation Methods



General Findings

- **CO_2 emission estimates easier to generalize based on fuel carbon content and other properties**
  - **Uncertainty range of 5-15% if estimate is based on heating values rather then carbon content knowledge**
  - **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**
  - **Require knowledge of specific emission sources**
- **Techniques presented, particularly for combustion and indirect emissions, have broader application to many other industries**

Comparative Study of Protocols

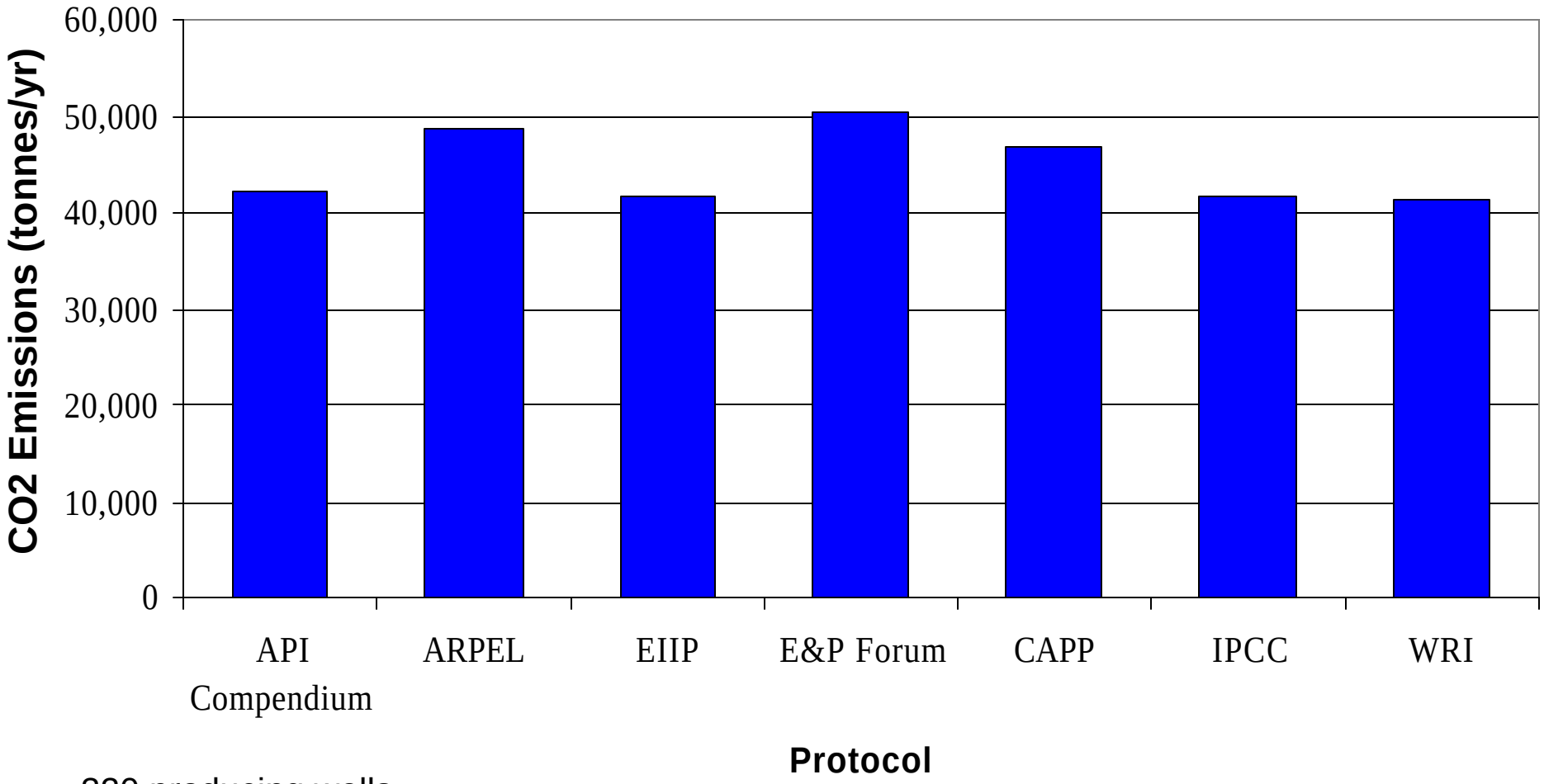
- **API Compendium issued as Draft in April 2001 for a 1-year review, commentary and testing**
- **Initiated comparison study with widely used GHG estimation protocols as part of "road-testing"**
- **Qualitative differences identified include:**
  - **Scope and treatment of emission sources,**
  - **Referenced data used, and**
  - **Documentation of emission factors derivation**
- **API derived quantitative comparison of calculated emissions for typical Oil & Gas facilities**
  - **Uses hypothetical facilities previously described in the API Compendium**

Protocols Used for Quantitative Comparisons

- Canadian Association of Petroleum Producers (CAPP), Global Climate Change Voluntary Challenge Guide (CAPP, 1999);
- Exploration and Production Forum (E&P Forum), Methods for Estimating Atmospheric Emissions from E&P Operations (E&P Forum, 1994);
- Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (IPCC, 1996; UNECE/EMEP, 1999; IPCC, 2001);
- Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL), Atmospheric Emissions Inventories Methodologies in the Petroleum Industry (ARPEL, 1998);
- U.S. EPA, Emission Inventory Improvement Program (EIIP, 1999);

Protocol Comparison – Onshore Oil Facility (CO_2 Rich)

[Preliminary Data]



- 320 producing wells
- Oil Production 6,100 bbl/day
- Gas production 30 million scf/day ;

Protocol Comparison – Onshore Oil Facility (CO_2 Rich)

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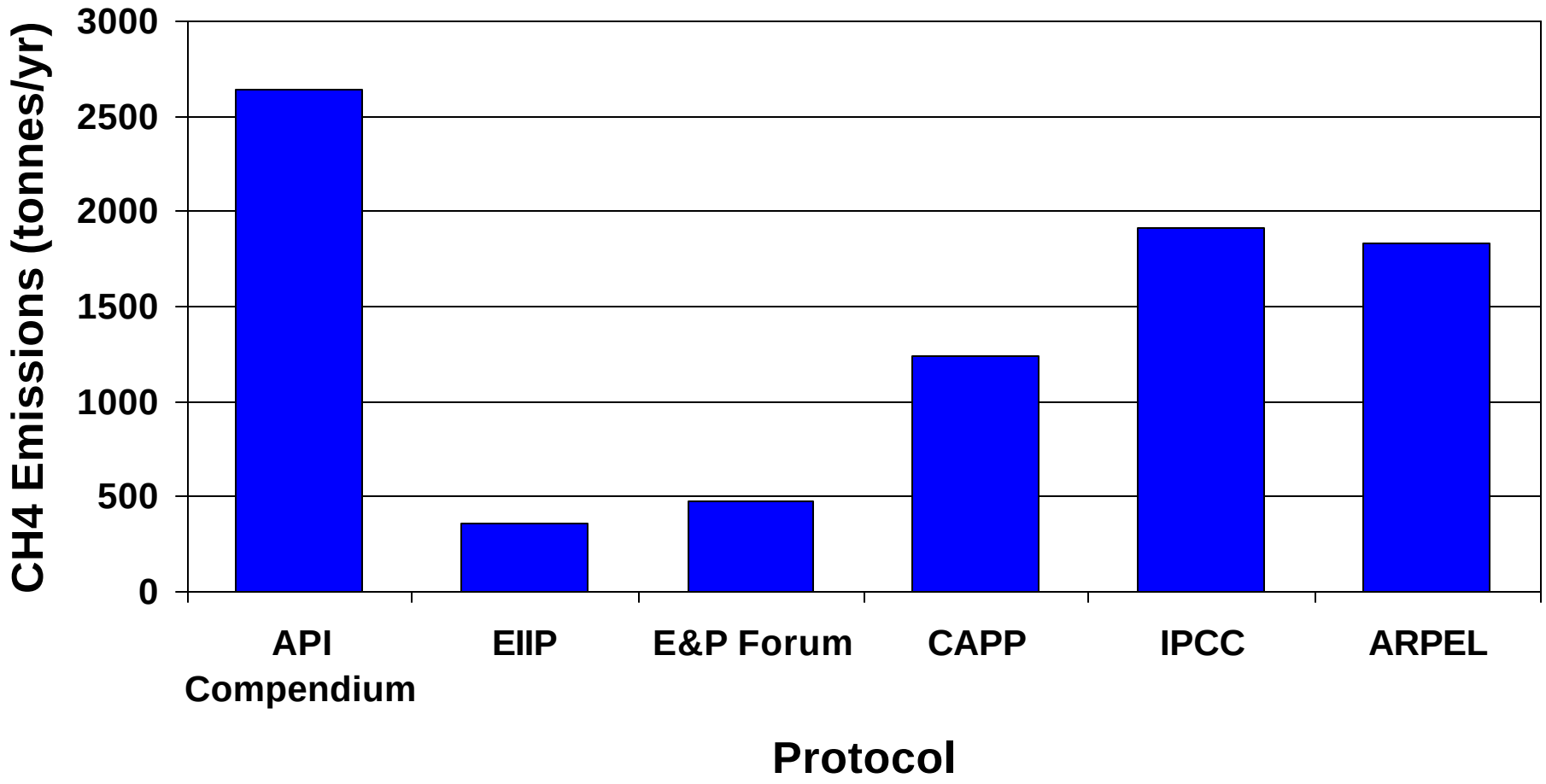

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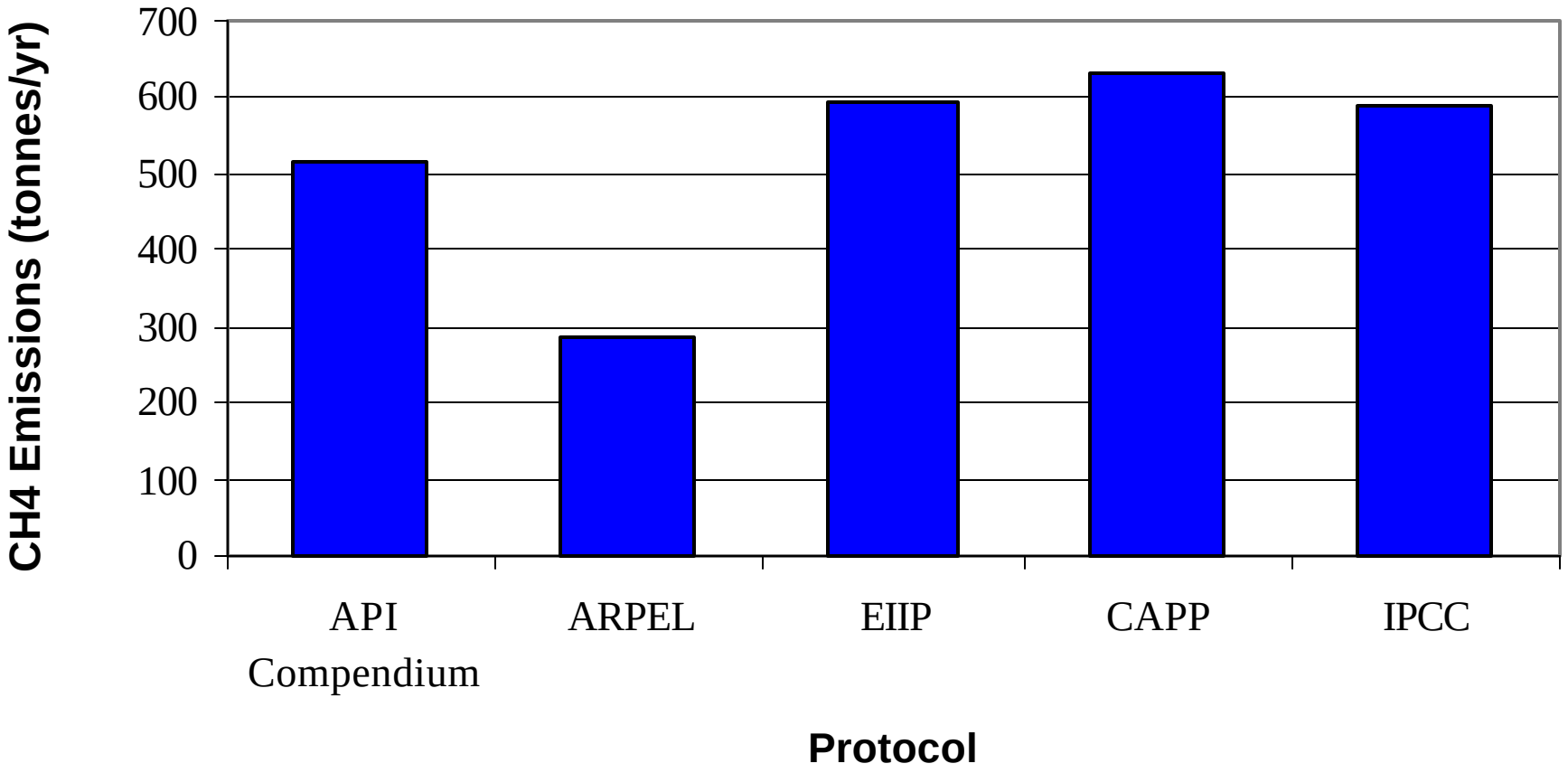
Protocol Comparison – Large Complex Refinery

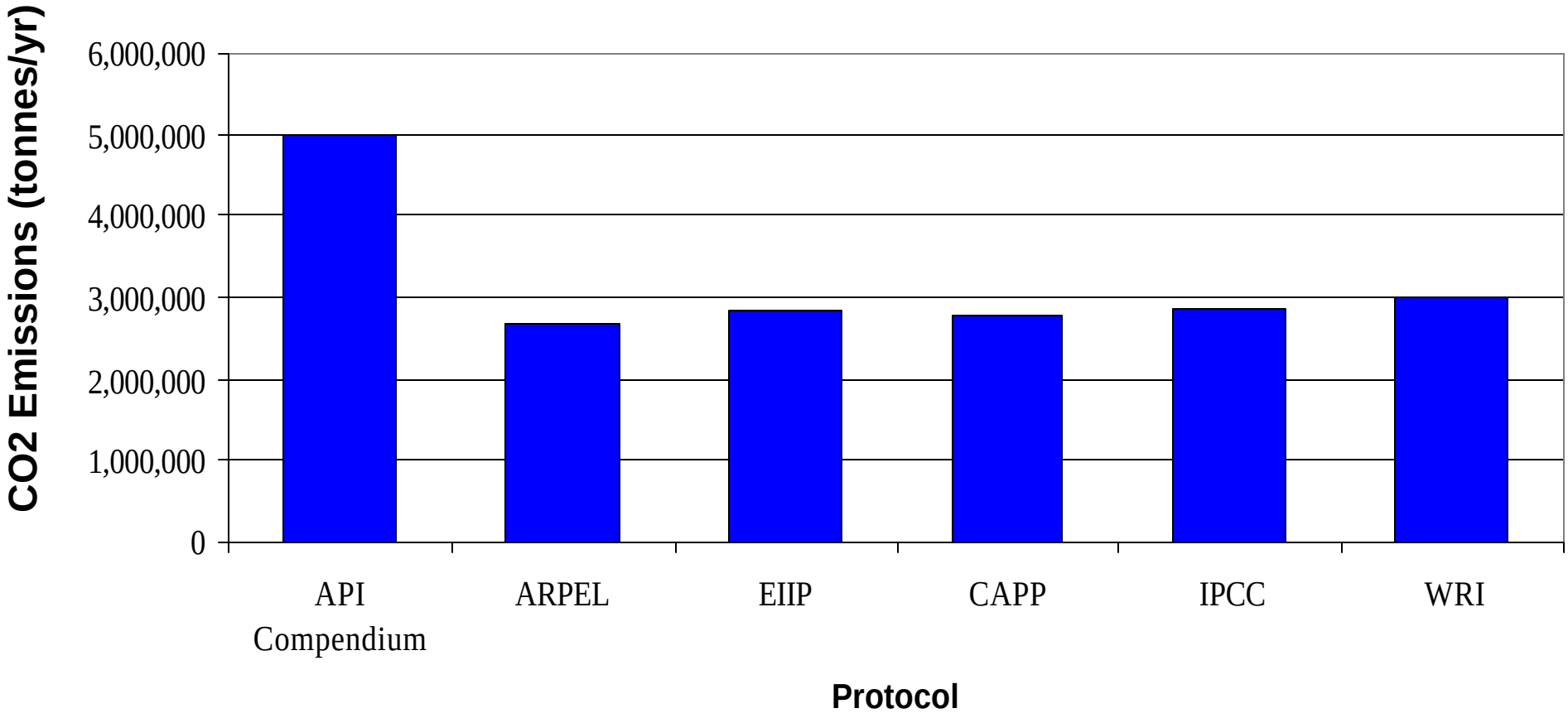
[**Preliminary Data**]



- Complex refinery
- Crude throughput 250,000 bbl/day

Protocol Comparison – Large Complex Refinery

[**Preliminary Data**]



- Complex refinery
- Crude throughput 250,000 bbl/day

Summary of General Differences

- **API Compendium and ARPEL quantify non-combustion emissions by source.**
- **EIIP, IPCC and E&P Forum generally combine non-combustion sources into one or two emission factors, making it difficult to determine exactly what sources are included.**
- **Significant variation in CH_4 emissions from combustion sources due to different versions of AP-42 (some date back as far as 1986). Not significant for CO2.**
- **Combustion CO2 variation due to different fuel property basis (e.g., IPCC on LHV basis)**

Summary of Differences for Industry Sectors

- **Production/Processing Operations:**
  - **API, ARPEL, and CAPP include tank flashing losses.**
  - **ARPEL and CAPP cite Canadian data resulting in 1/3 of the API emission estimate which is based on both Canadian and US data.**
- **Refining:**
  - **API only includes combustion CH4 releases.**
  - **EIIP and IPCC emissions result primarily from non-combustion sources.**
  - **CAPP turbine emissions are 4 to 5 times higher than other protocols.**
  - **API accounts for CO2 vented from cat. cracker regeneration**

Conclusions

- **Combustion CO2 emissions dominate most inventories**
  - **For some facilities CH_4 is significant compared to total CO2-Equivalent emissions**
- **Documentation of calculation methods and transparency of other assumptions is key**
- **Some Protocols lack needed detail to**
  - **Understand the derivation of emission factors, and**
  - **Allow for appropriate application to other scenarios.**
- **Quantitative comparison, using typical facilities, enables a better understanding of differences noted in the qualitative evaluations**

Further Information

- **Mail Orders**

  API Publications c/o Global Engineering Documents

  15 Inverness Way East, Mail Stop C303B

  Englewood, CO 80112-5776

- **On-Line**

  www.global.ihs.com

- **By Telephone**

  1-800-854-7179

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Indirect Emissions

- API Compendium addresses indirect emissions from electricity, steam, and cogeneration
- Allocation of these emissions associated with imports and exports addressed in other protocols
- US utility information readily available for CO2, some potential issues for CH4
- International data combines heat and electricity