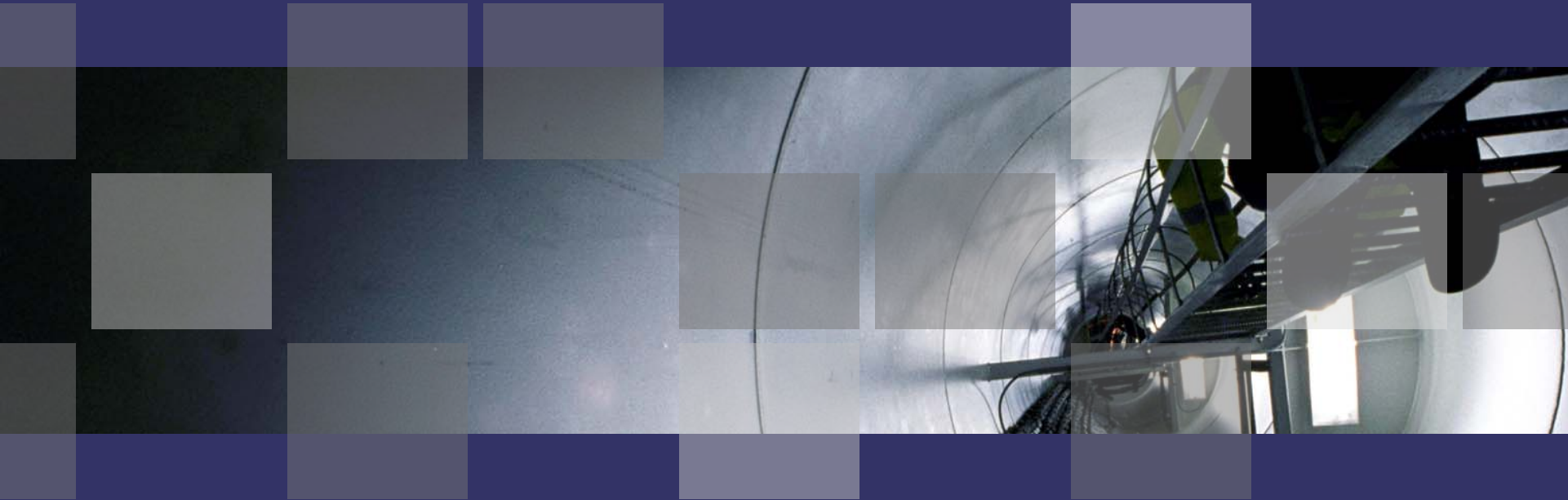


# A STUDY OF ENVIRONMENTAL BENEFITS OF INDUSTRIAL INTEGRATION



Presented to  
**Hydrocarbon Upgrading  
Task Force**  
Calgary, Alberta

Presented By:  
**AMEC EARTH & ENVIRONMENTAL**  
Edmonton, Alberta  
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## Objectives of this Study

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- ❑ To establish environmental benefits, if any, associated with Integrated Complex
- ❑ Conduct a comparison of Standalone facilities with the conceptual design of the Integrated Complex
- ❑ Use of results for the development of a Industry business case and future policy direction

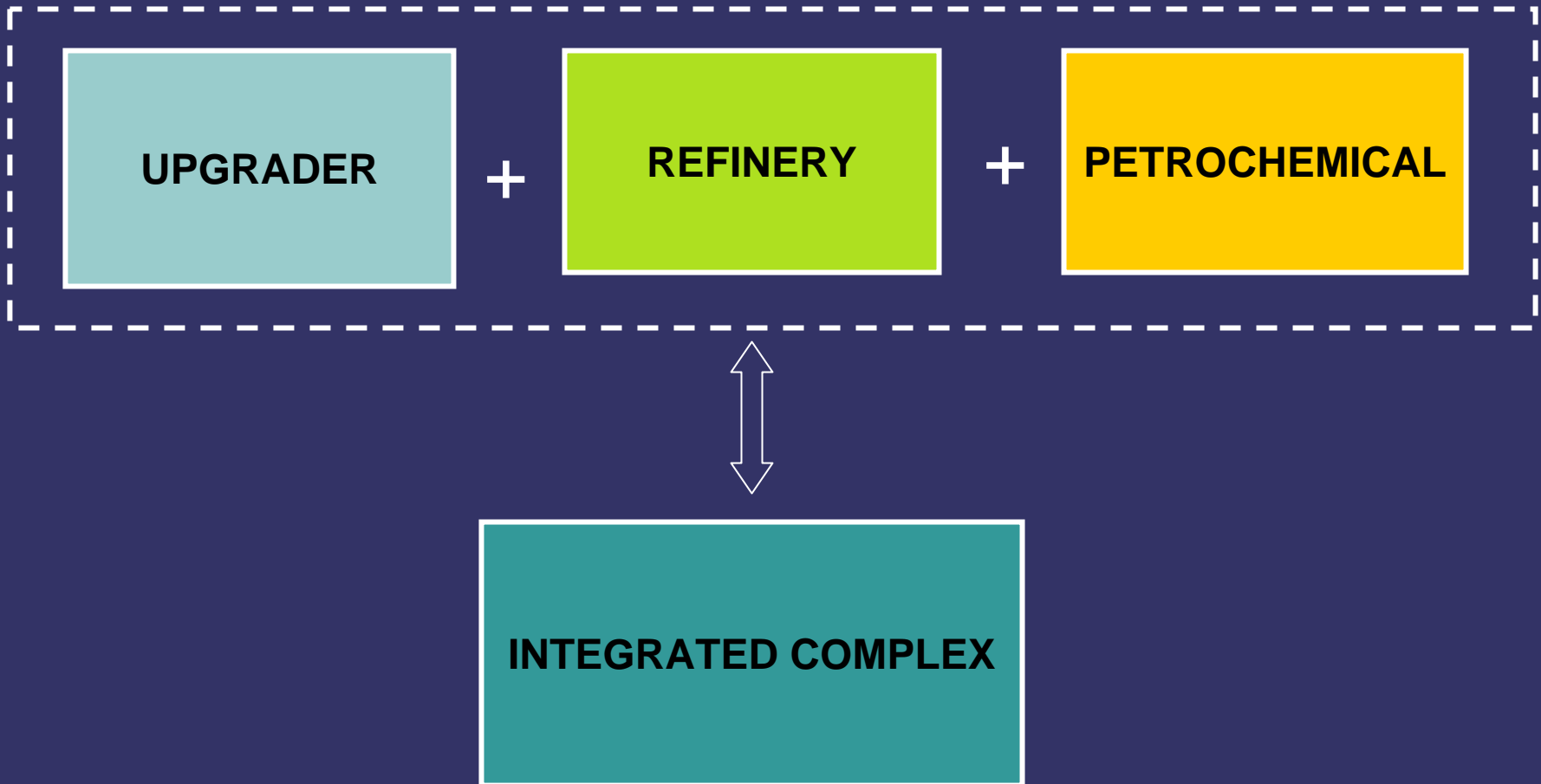
## Study Approach

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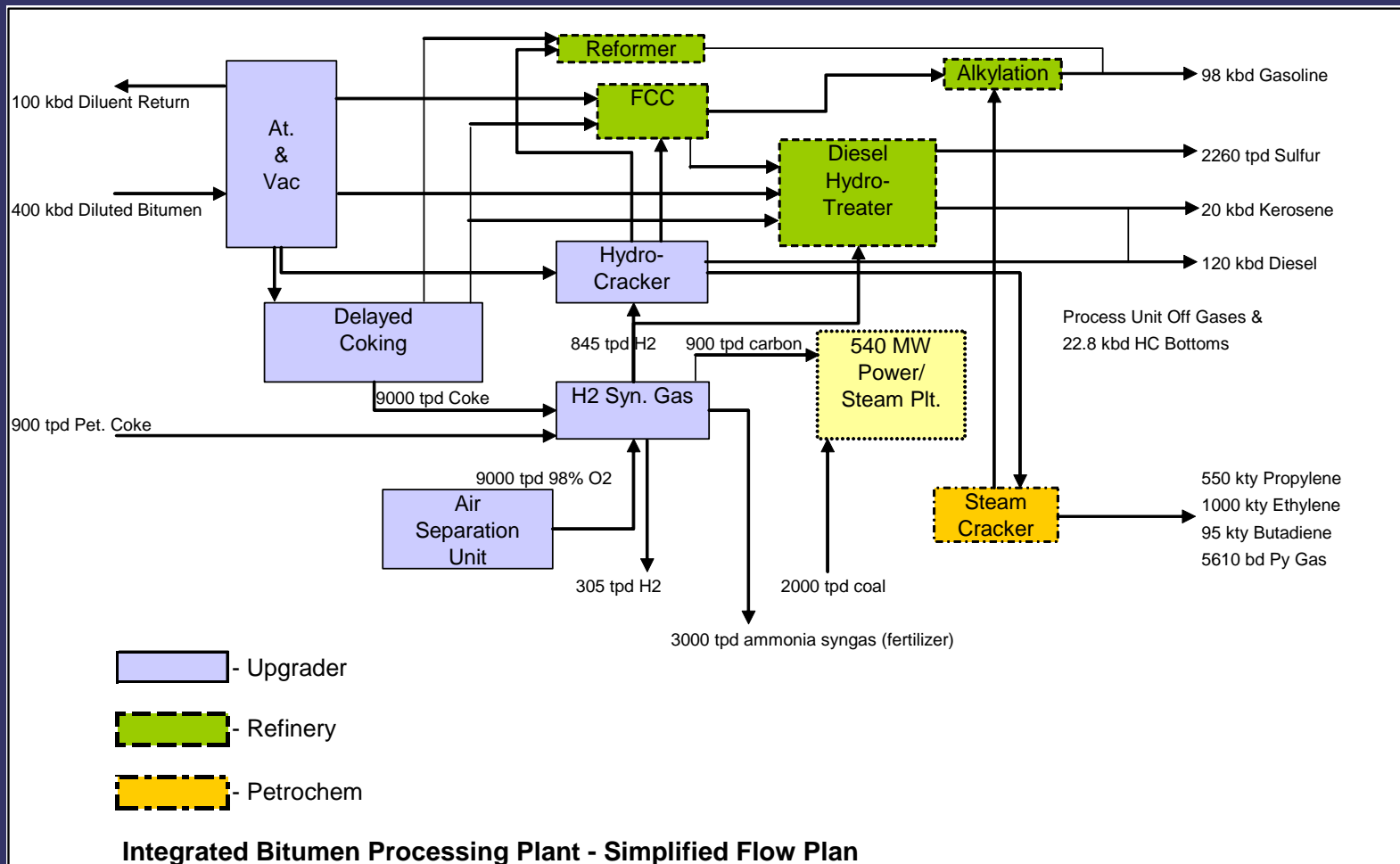
- ❑ Broad based approach was used to quantifiably and accurately compare the environmental benefits of Integration
- ❑ Integrated Complex was compared against existing facilities in Alberta
- ❑ EIA submissions from various operators was used as primary data source
- ❑ Environmental receptors included Air, Land, Water and Waste

# Integrated Complex Components

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# Integrated Complex - Detail



## Required Steps for Comparison Analysis

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- ❑ Choosing the standalone facilities
  
- ❑ Combinations of standalone facilities
  
- ❑ All facilities normalized based on throughput
  - Bitumen feed to upgrader: 300,000 bbl/sd
  - Synthetic crude to Refinery: 260,000 bbl/sd
  - Olefin feed to Petrochemical: 1910 KTA.

## Combination of Standalone Facilities

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Following combinations were created based on the five facilities:

❑ **UA + R1 + P1**

❑ **UB + R1 + P1**

❑ **UA + R2 + P1**

❑ **UB + R2 + P1**

## Environmental Comparison – Air Emissions

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- ❑ Selection for air pollutants was based on the consistency of EIA information
  
- ❑ Comparison analysis focused five major air pollutants
  - Sulphur Dioxide
  - Nitrogen Oxides
  - Carbon Monoxide
  - Particulate Matter
  - Carbon Dioxide

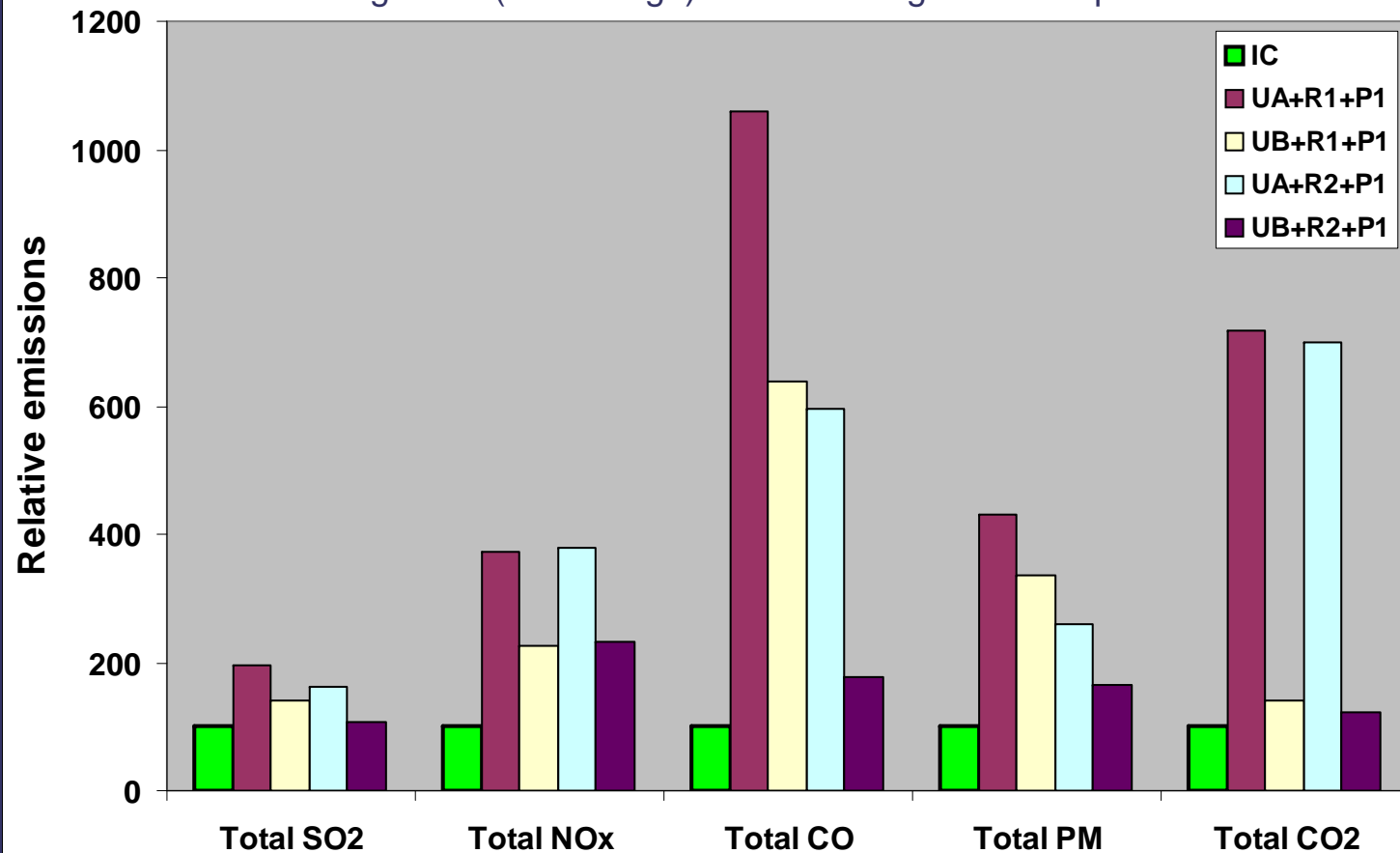
## Comparison of Estimated Air Emissions

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- ❑ Throughput rates for standalone facilities were normalized to the throughput of the Integrated Complex
- ❑ No detailed information for the Integrated Complex was available in the Integration Study
- ❑ Rationalized by matching similar emitters in standalone and Integrated Complex
- ❑ Total emissions are sum of the emissions from all the plant units

# Relative Emissions

Air emissions from the standalone facilities range from 1.5 to 5.1 times greater (on average) than the Integrated Complex

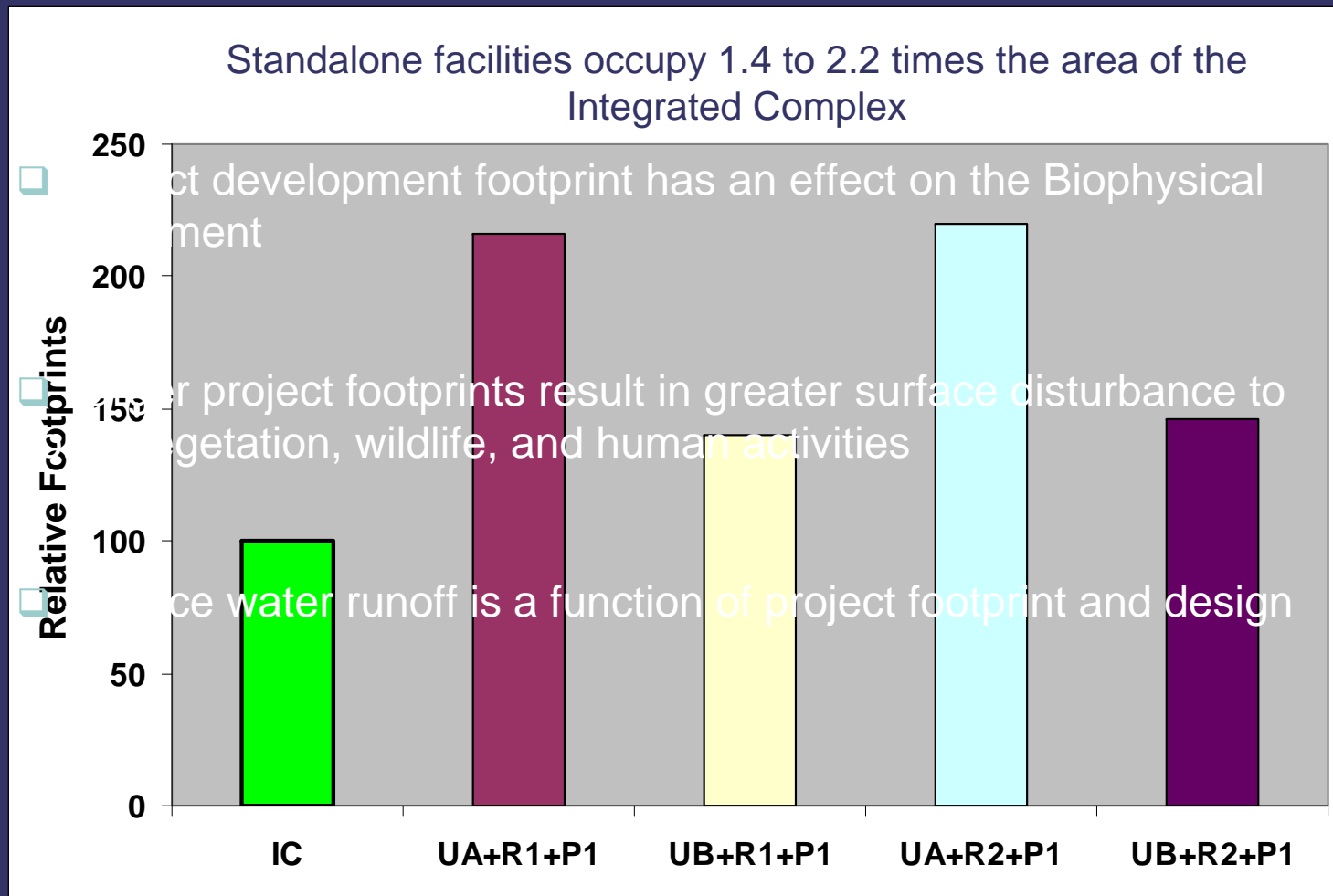


# Dispersion Modeling

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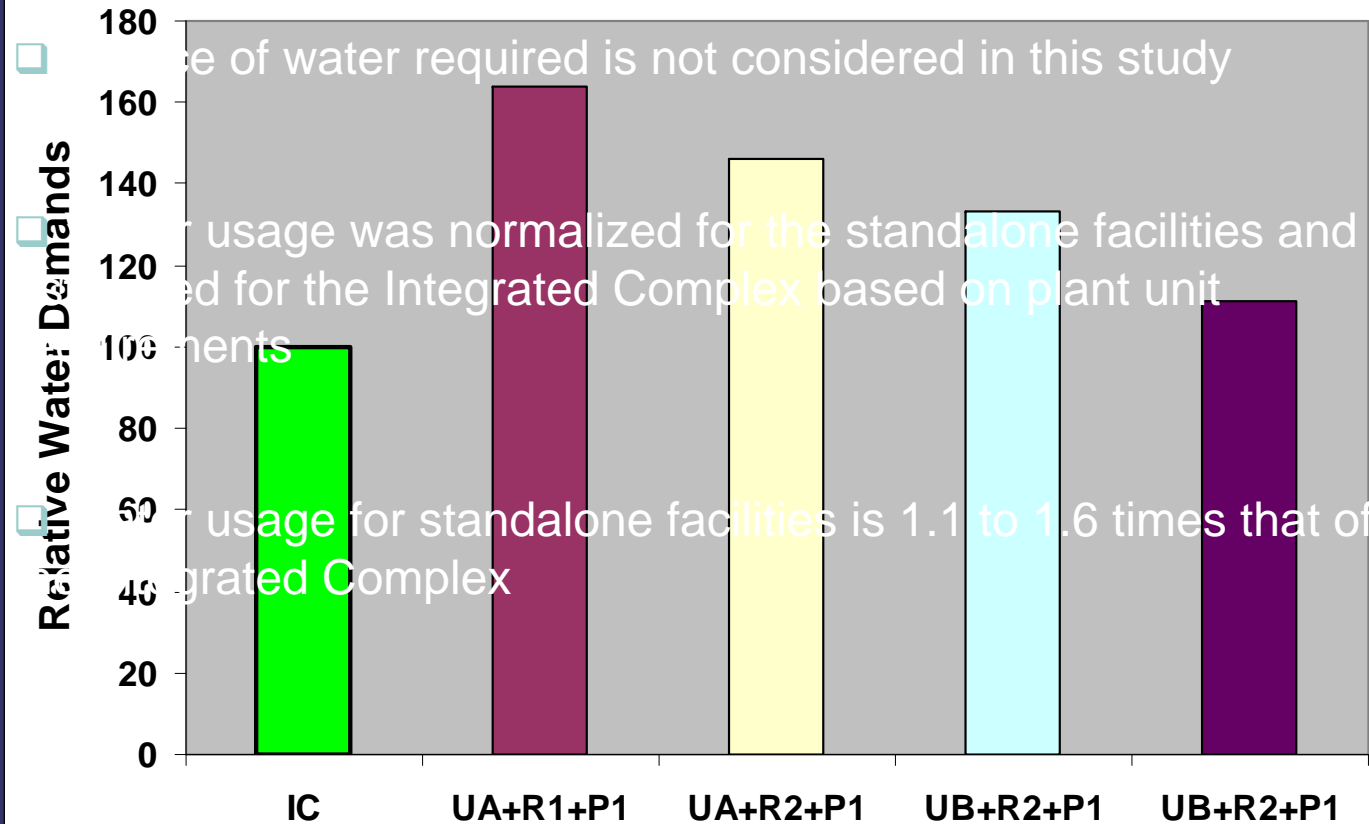
- ❑ Dispersion modeling of air emissions not possible due to:
  - Different processes and technologies
  - Unknown geographic location
  - No detailed engineering design

# Footprint Comparison



# Water Demand

Water demand for the standalone facilities ranges between 1.1 and 1.6 times greater than the Integrated Complex



# Synergy for Utilization of Waste Streams

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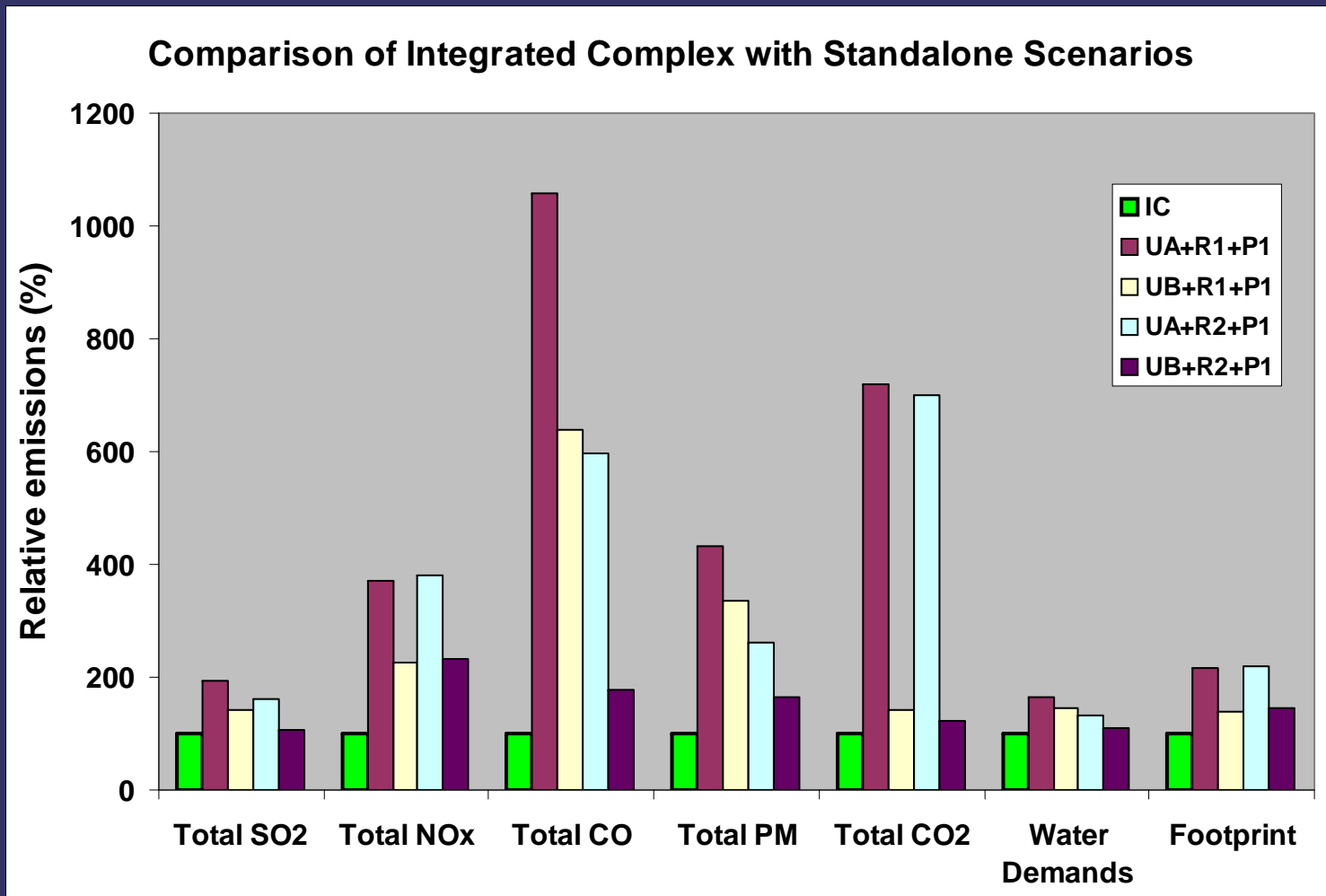
- ❑ Waste Streams (both Gas and liquid)
  
- ❑ Gas streams usually end up as fuel gas
  
- ❑ Liquid streams used as low value products or as fuel
  
- ❑ IC uses waste streams as feed for the Olefin production facility
  - Value added products generated (~ 2000 KTA)

## Conclusions

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- ❑ Normalized air emissions for SO<sub>2</sub>, NO<sub>x</sub>, CO, PM and CO<sub>2</sub> order of magnitude lower in IC.
- ❑ Number of emitters in standalone facilities 1.2 – 1.8 times higher.
- ❑ Standalone fugitive emissions expected to be 1.5 to 2.0 times higher.
- ❑ Footprint higher by 1.4 to 2.2 times for standalone facilities.
- ❑ Dispersion modeling not possible.
- ❑ Waste comparison not possible but expected to be lower in IC.
- ❑ Water demand higher by 1.1 to 1.6 times for standalone facilities.

# Summary of Environmental Benefits



## Path Forward

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- ❑ Detailed engineering on IC to make detailed evaluation of technical feasibility and costs.
- ❑ More precise definition of environmental impact through more detailed engineering studies
- ❑ Requirements of water, power, infrastructure needs, and waste outputs to be better defined for IC
- ❑ Dispersion modeling based on proper site selection
- ❑ Industry participation
- ❑ Market evaluation and defining potential markets for the value added products
- ❑ Development of Policy supporting the Integration process