

Complexity-Weighted Barrels Methodology for California Refineries (CA-CWB)

For CARB Refinery Workshop
August 13, 2013



Solomon Associates
M³ – Measure. Manage. Maximize.®

About Solomon Associates

Over 30 years as worldwide industry leader in
Benchmarking and Performance Improvement Services



**World's largest
databases of
operating
performance**



**Large inventory of
Industry Best
Practices**



**Staff of industry
experts**

**Most with >30 years
industry experience**

Enhance performance and maximize profits

Third-party objective | Absolutely confidential

Comparative Performance Analysis

More than Benchmarking – Unique to Solomon Associates

Practical Focus competitive and efficiency bases

Comprehensive metrics across every area

Normalized allowing better comparisons

Accurate validated by industry professionals

Unique Methodologies provides focus

Value

“Fair, Independent, and Accurate” representation of client performance

Objective standard for comparison to regional peer plants or other peers according to market mission

Sufficient detail and tools to identify and quantify improvement opportunities

Ability to compare all plants within company – resource allocation

Analyzing Performance Around the Globe

Fuels Refining

Worldwide

Gas Processing Plants

New Worldwide Study

Pipelines

Liquid Pipeline

NG Pipelines

Terminals

Lubes

Worldwide

Butadiene

Worldwide

Power

Coal

Gas & Oil

CCGT & Cogen

Styrene

Worldwide

Olefins

Worldwide

Upstream – NEW!

Worldwide

Companies in more than

70 countries rely

on Solomon; our metrics have become the standard for gauging performance around the world.

GHG Regulatory Support

Working with our clients and regulatory agencies

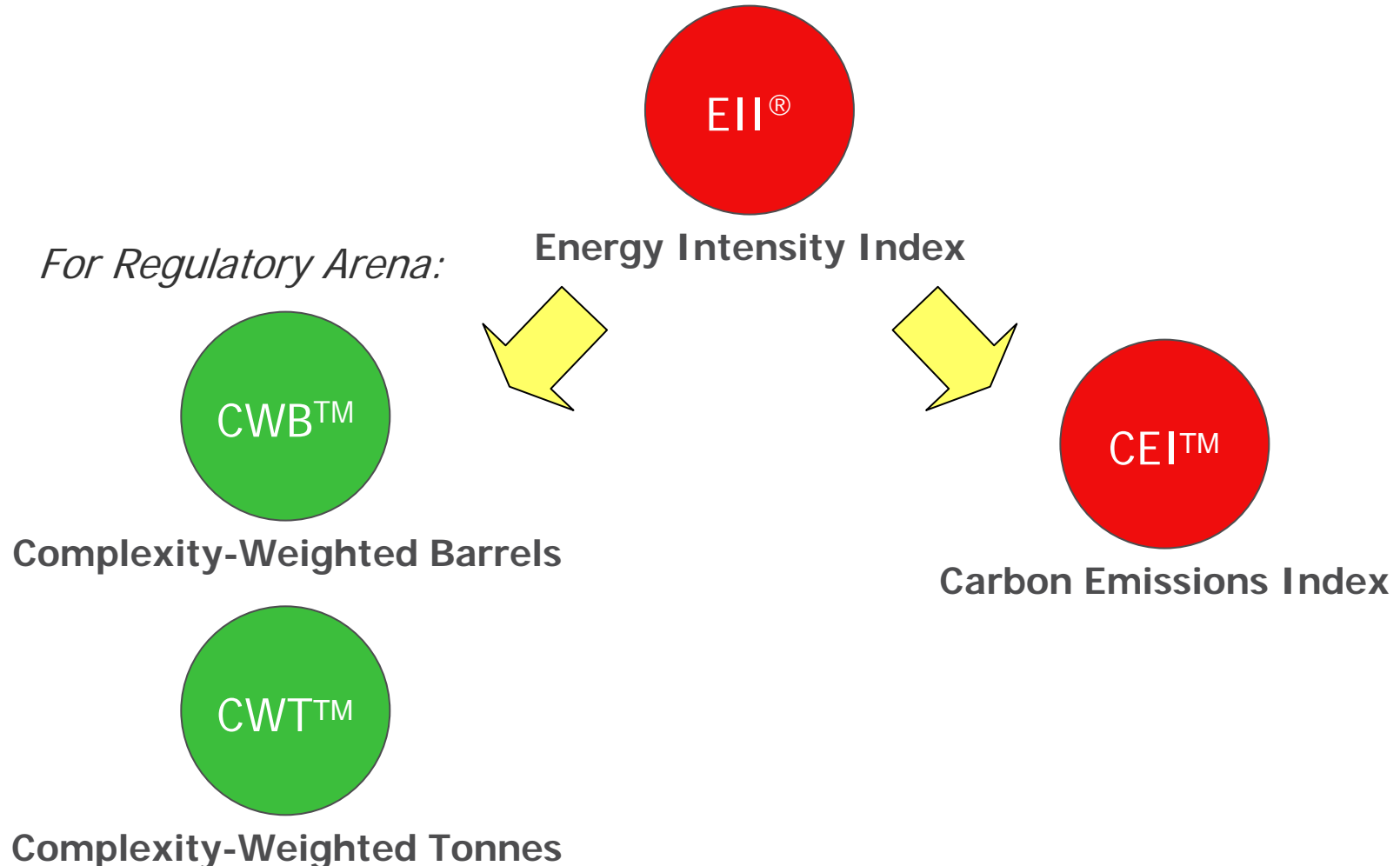
- Helping to find a way forward around the world
 - Europe
 - Japan
 - Netherlands
 - Canada
 - New Zealand
 - California
 - US EPA ENERGY STAR
 - Other countries
- Customized approaches to meet specific needs of each region

CWB and CWT

Both of the Complexity-Weighted Barrels (CWB™) and the Complexity-Weighted Tonnes (CWT™) methodologies are proprietary to Solomon.

Solomon grants the client (typically a regional Industry Association) limited rights to use or promote the methodology for the purpose of GHG regulations, under a Consulting Services Agreement.

Solomon Metrics for GHG Benchmarking



- (1) "Benchmark": Divisor in an intensity metric, GHG emissions per CWB or CWT
- (2) "Cap and Trade": Basis for allocating emission allowances

What are CWB and CWT?

CWB – an equivalent *barrel* divisor for refinery throughput indicative of GHG emissions potential based on a refinery's configuration and processing complexity

CWT – an equivalent *tonne* divisor for refinery throughput indicative of GHG emissions potential based on a refinery's configuration and processing complexity

CWB vs CWT

CWB

- Prototype developed during an *Emissions Allocation Study* for WSPA around 2008
- For North American refineries measuring throughput in barrels

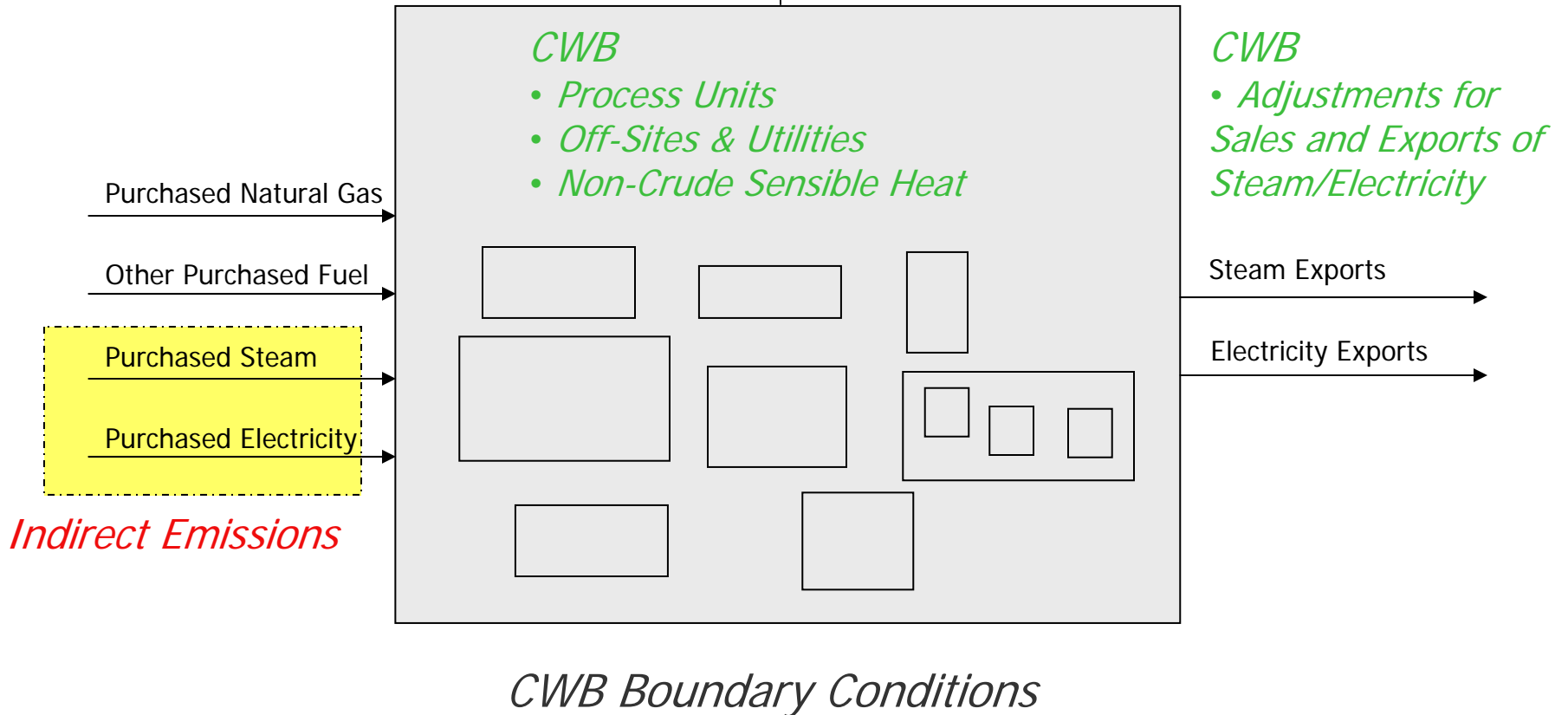
CWT

- Developed for CONCAWE under the EU GHG Emissions Trading Scheme (ETS) Directive ("EU-CWT") in 2008–2009
- Customized for EU average fuel mix and feed characteristics
- Simplified vs CWB by combining a number of process unit categories and process types
- Can be modified for refineries in other regions using metric units of measure

Solomon CWB Boundary

On a Total Emissions Basis

Direct Emissions

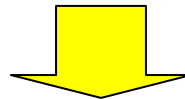


Process CWB

Process CWB

= Σ (Daily Throughput Barrel¹ × CWB Factor)

$$\text{CWB Factor } \textit{for Unit} \\ \textit{(or Unit Grouping)} \times = \frac{\text{CO}_2\text{e Emissions Standard per barrel throughput}^1 \\ \textit{for Unit (or Unit Grouping)} \times}{\text{CO}_2\text{e Emissions Standard} \\ \text{per barrel throughput}^1 \text{ for CDU}}$$



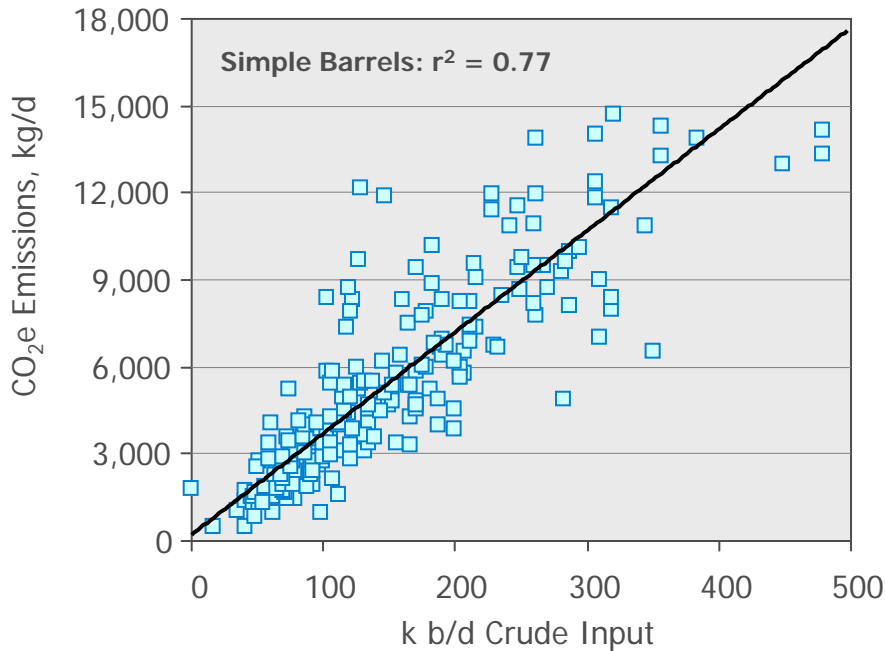
- Accounts for Refinery Process Unit Configuration and Complexity
- Approx. 60 CWB Factors

¹ Units of Measure – Certain process units are based on product, rather than feed (throughput); alternative units are used in accordance with industry convention (e.g., short tons of product for coke calciner)

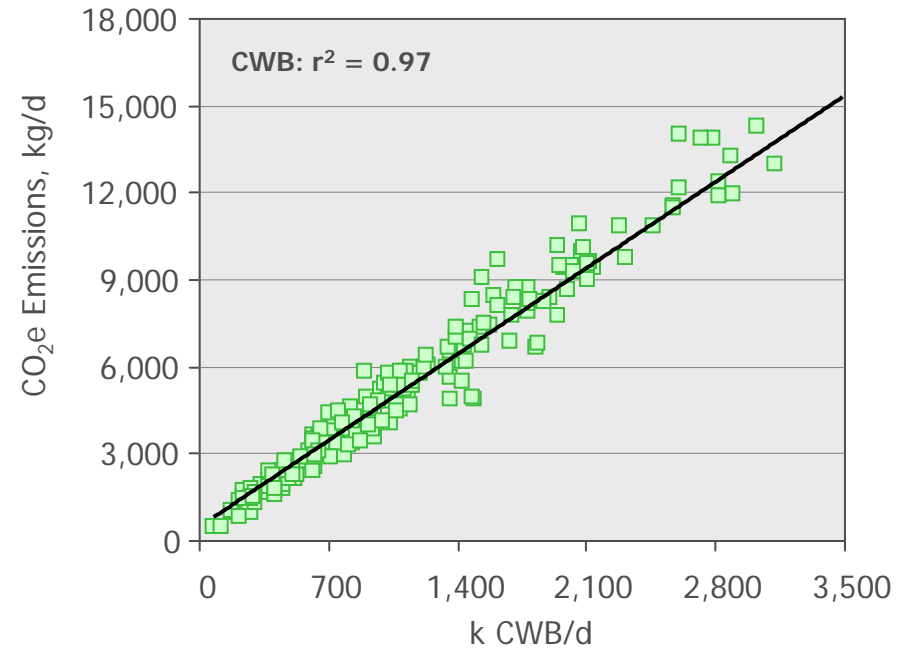
CWB Robustness in Allocating Emissions

Simple Barrels vs CWB

CO₂e Emissions vs Crude Input



CO₂e Emissions vs CWB



(Operating Year 2010; Approx. 200 OECD Refineries)

Summary

- CWB is robust to benchmark a wide range of refining process configurations
- CWB can be applied to big or small refineries
- CWB can be customized for
 - Boundary Conditions (Total vs Direct-Only Emissions)
 - Reference Fuel
 - Streamlining – Combination of process units
- “Atypical” refineries may be handled separately
 - Extremely small sizes
 - Performing predominantly specialized functions (such as bitumen production or lube oil manufacture)
 - Atypical product slate (such as <40% light products including motor gasoline, aviation gasoline, kerosene, and diesel/heating oil)

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