GRABNER INSTRUMENTS | AMETEK OIL & GAS

ON-LINE BLENDING

Optimizing refining margins by minimizing Octane and VP give-away

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CLEAR VISION SOUND STRATEGIES SOLID PERFORMANCE

„The GOAL of any company is to make money by simultanously increasing net profit, ROI and cash flow …“

THE GOAL by Eliyahu Goldratt (1984)

Improvement of refining margins

Price – Cost = Profit

(1) Process efficiency → Minimum Giveaway Strategy

- Reduce costs through increased efficiency (Advanced Process Control, APC e.g. by installing automatic on-line blending systems)

(2) Resource efficiency → Minimum Cost Strategy

- Reduce costs through optimized supply chain (e.g. select the least costly combination of blend components)

→ Refiners should focus on increasing process efficiency as primary optimization strategy and minimizing supply cost as secondary.

Agenda

1. WHAT WE GIVE AWAY
   - Of Relevance: Octane and RVP
   - Potential Savings
   - Accuracy Effect
2. BUTANE BLENDING
   - What is VP (Vapor Pressure)
   - Profit Through Butane Blending
   - Blending Facility Examples
3. EQUIPMENT
   - Online Blending Tools
   - FTIR and VP Blending Setup

1. WHAT WE GIVE AWAY

GIVE AWAY - Definitions

- COMPARISON of what you had done to how good you would have done
- COMPARE the (quality) data with the requirements
- DIFFERENCE between the target and the actual in any of the proterties (RVP, Octane, T50, …)

➢ Difference in $$$ to justify blending optimization

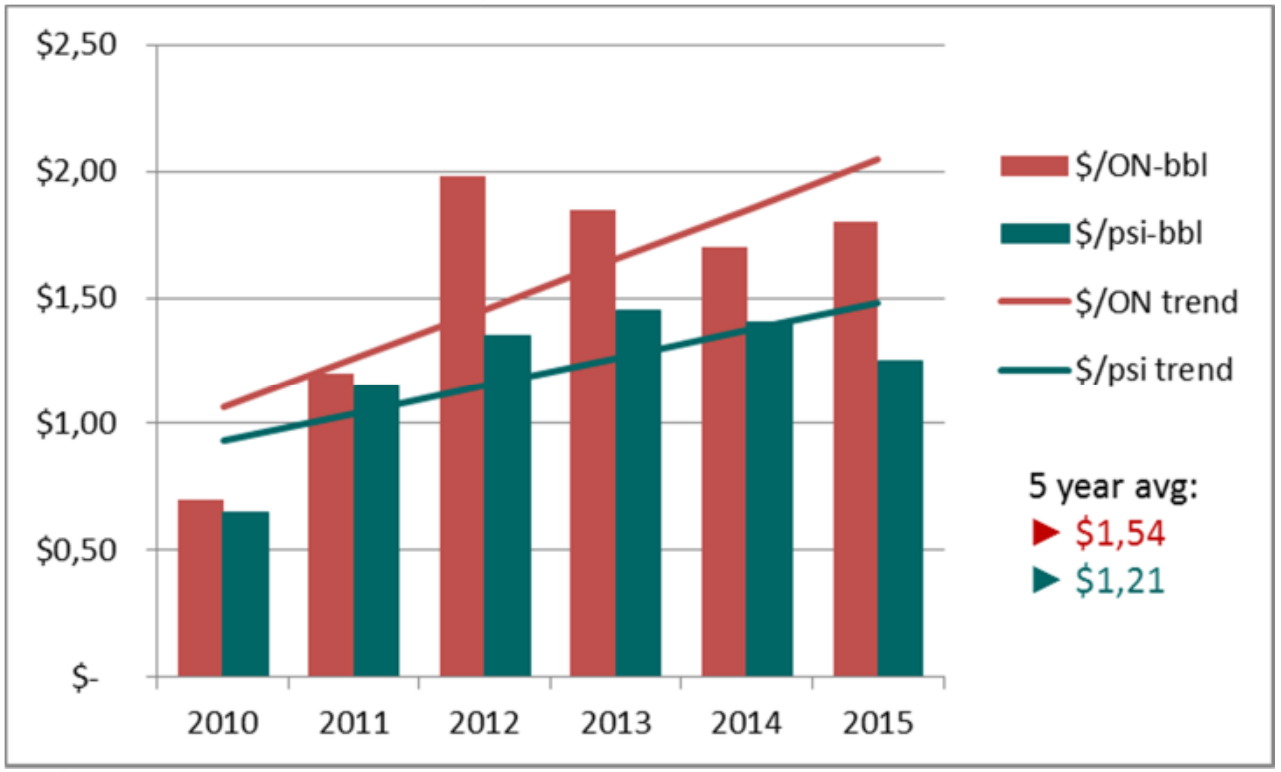
Gasoline Blending: VP and ON

- Vapor Pressure (RVP, DVP, DVPE, ASVP, TVP …)
  - Max VP strictly regulated
  - High VP components cheap vs low VP components
  - V/L, T50 and VOC convertible to VP equivalents
- Octane (ON) Rating (RON, MON, AKI)
  - Min ON Regulations for Gasoline grades
  - Regular grade cheap vs premium grade (Super)

➢ ON-barrel (ON-bbl) and psi-barrel (psi-bbl) → $$$

Octane (ON) and VP Market Prices

The concept of octane and psi barrel allows to attach a price tag to the give-away properties of gasoline.

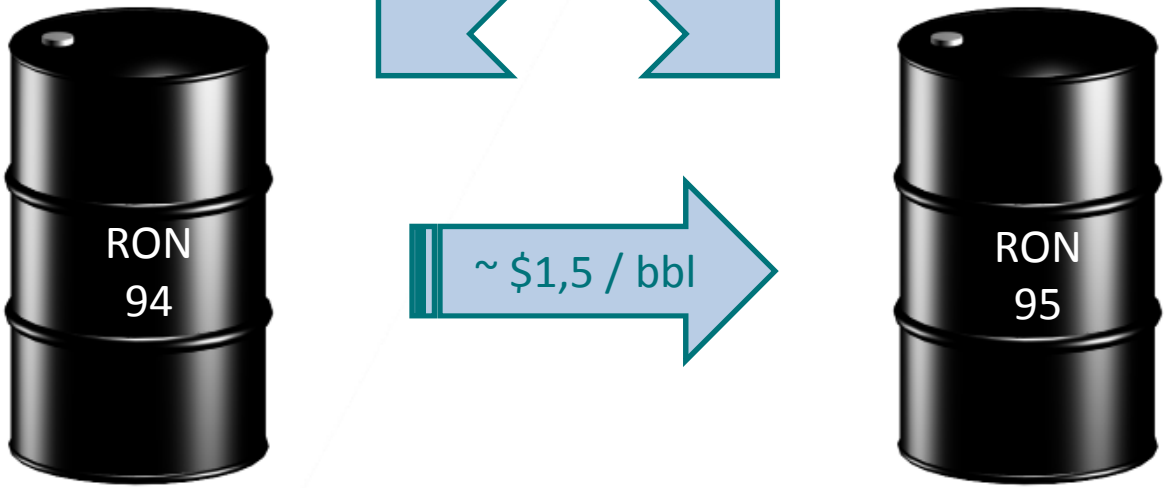


* Source: Valero, USA

Octane Barrel (ON-bbl)

Cost:

Gasoline Supply

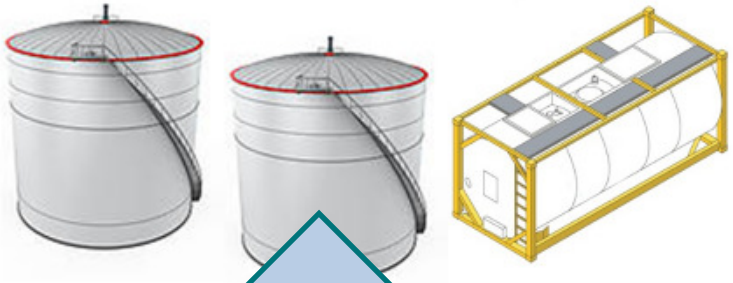


5 year avg:
- $1,54
- $1,21

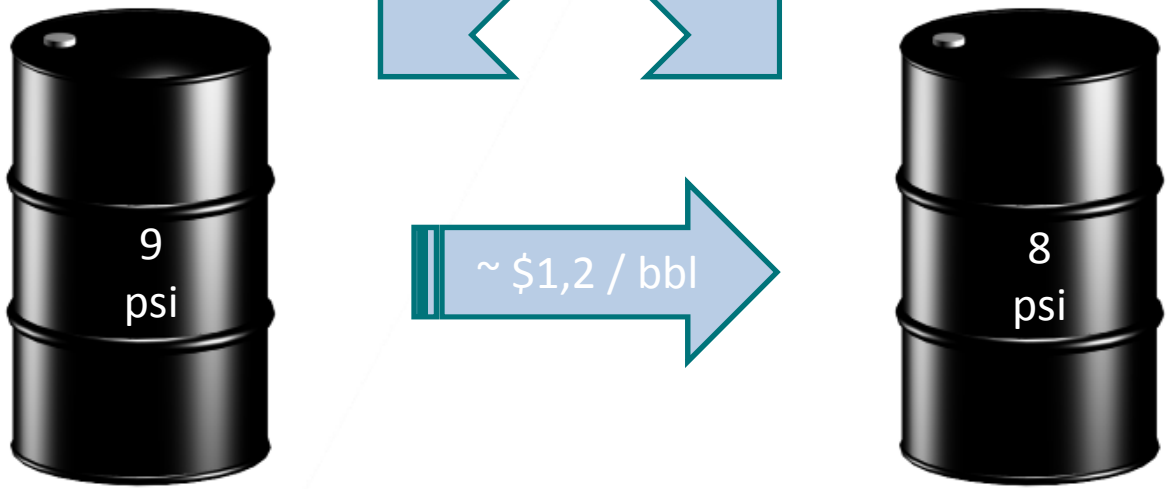
Price: $X/bbl $(X+1,5)/bbl

Vapor Pressure barrel (psi-bbl)

Cost:



Gasoline Supply
Butane Supply

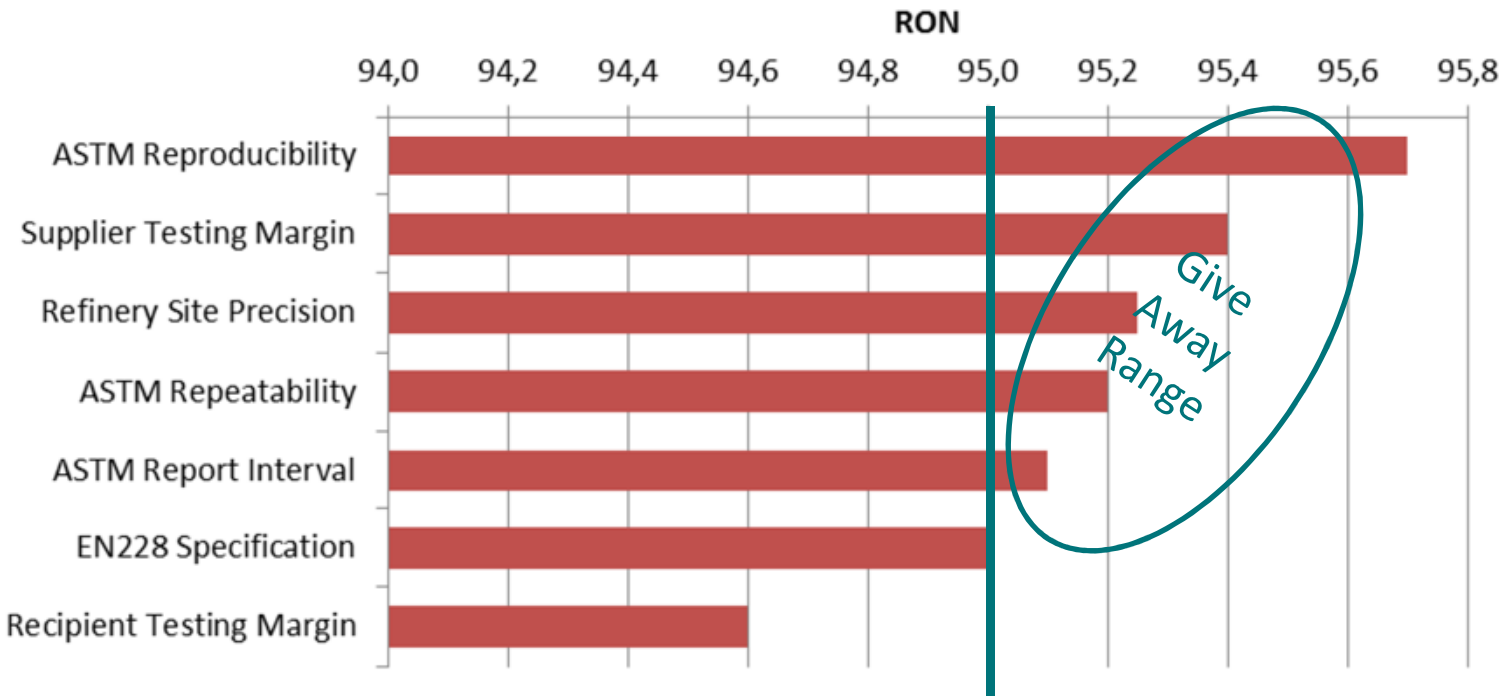


5 year avg:
- $1,54
- $1,21

Price: $X/bbl $(X+1,2)/bbl

Minimum Specification for RON (in EN228)

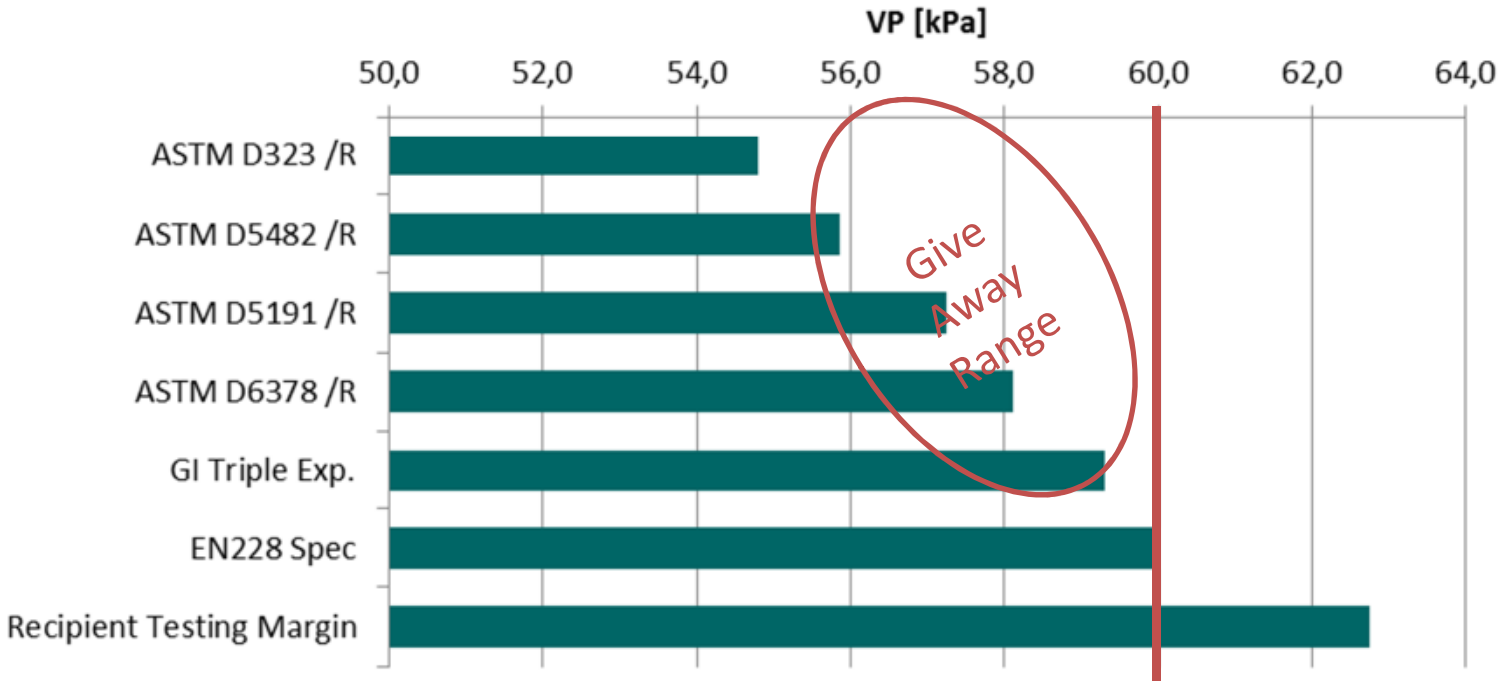
RON Control above Sales Target



Industry avg. estimate on ON give away is above 0,5 in US

Maximum Specification for DVPE (in EN228)

VP Control below Sales Target



Industry avg. estimate on VP give away is around 0,4psi (2,8kPa) in US

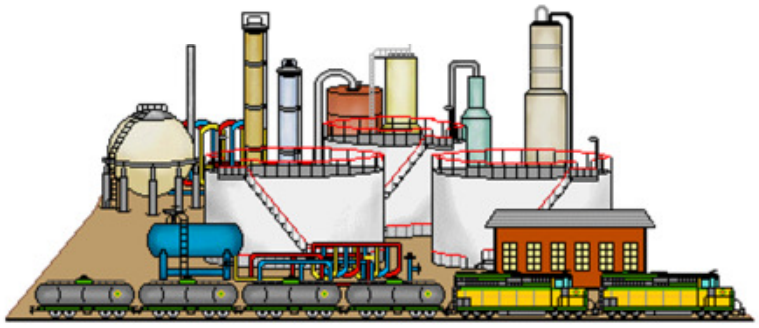
Potential Give Away Profit/Loss

Potential of combined give away savings				assumptions	
Region	**US**	**EU**	**RU**	**unit bbl**	**avg. R**
production [Mbbl/d]*	8,70	7,50	3,80		
ON [M$/d]	9,14	7,88	3,99	$1,5	0,7 ON
RVP [M$/d]	4,31	3,71	1,88	$1,2	0,4 psi
total [M$/d]	13,44	11,59	5,87		
total annual [M$]	**4.906**	**4.229**	**2.143**		

* Source: World Refining Survey 2014; EU incl. Turkey and RU incl. CIS

„…the monetized difference in gasoline property give-away … between the bottom 25% and the best performing 25% [is] being more than $1,30/bbl…“

NORTH and SOUTH AMERICA GASOLINE
and DIESEL QUALITY ANALYSIS by
Solomon & Associates (2010)



2. BUTANE BLENDING

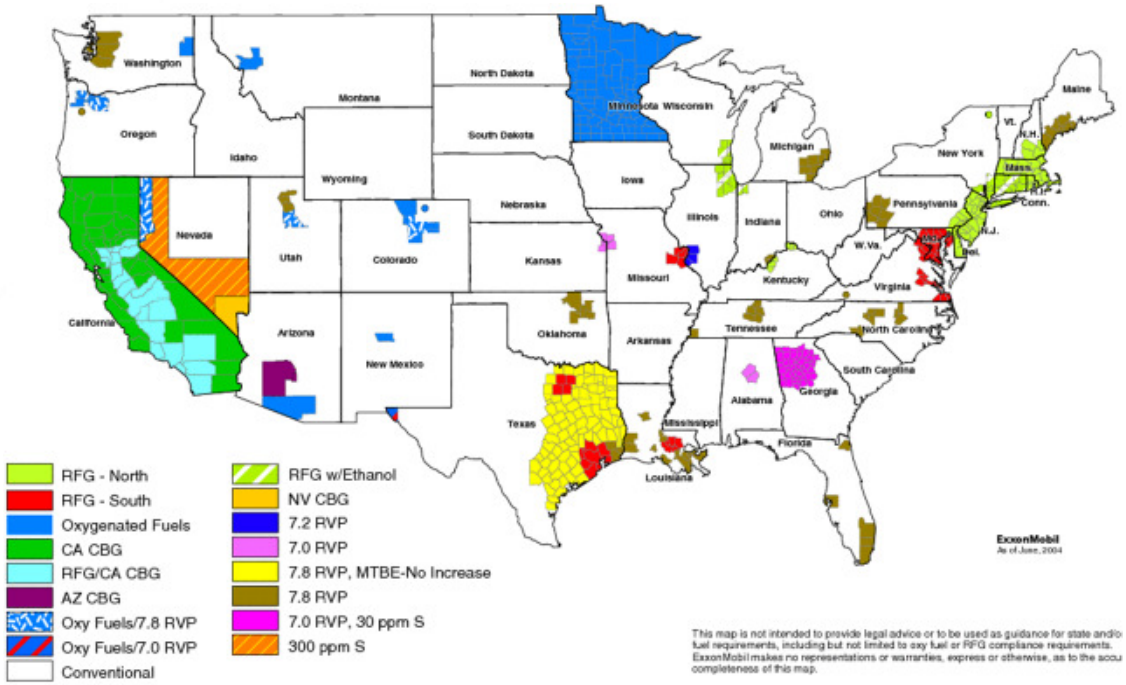
Target: Vapor Pressure

- **Regulations**
  - Environmental / technical standards
- **Safety**
  - Transportation and storage
- **Profit optimization**
  - C4 blending in refineries and pipelines

Profit Optimization

- Butane Blending
  - Low cost volatiles (C4)
  - Reformulated gasoline ($$)
  - Blend to required VP

- Summer blend
  → more expensive
- Winter blend
  → less expensive
- Regional blend
  → optimized



Profitability: Measure your Profit

Butane: $0.67 per Gallon
Gasoline: $1.92 per Gallon
Profit: $1.25 per Gallon

How can I make money?

- Add butane to RFG (1% to 5%)
- Sell blended RFG at market price
- Butane fraction sold at RFG price
- Butane costs are lower than RFG costs

→I MAKE MONEY!

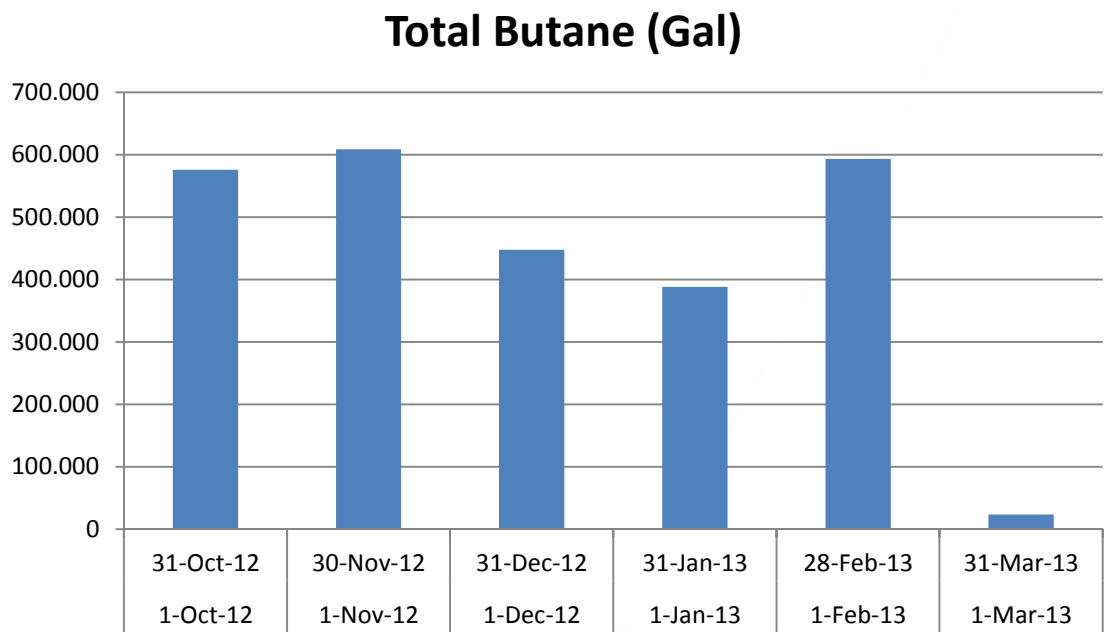
How much money do I make?

- VP of butane, RFG
- Calculate fractions that meet VP requirements
- Cost of butane, RFG
- Calculate cost difference (spread)

→ Calculate PROFIT

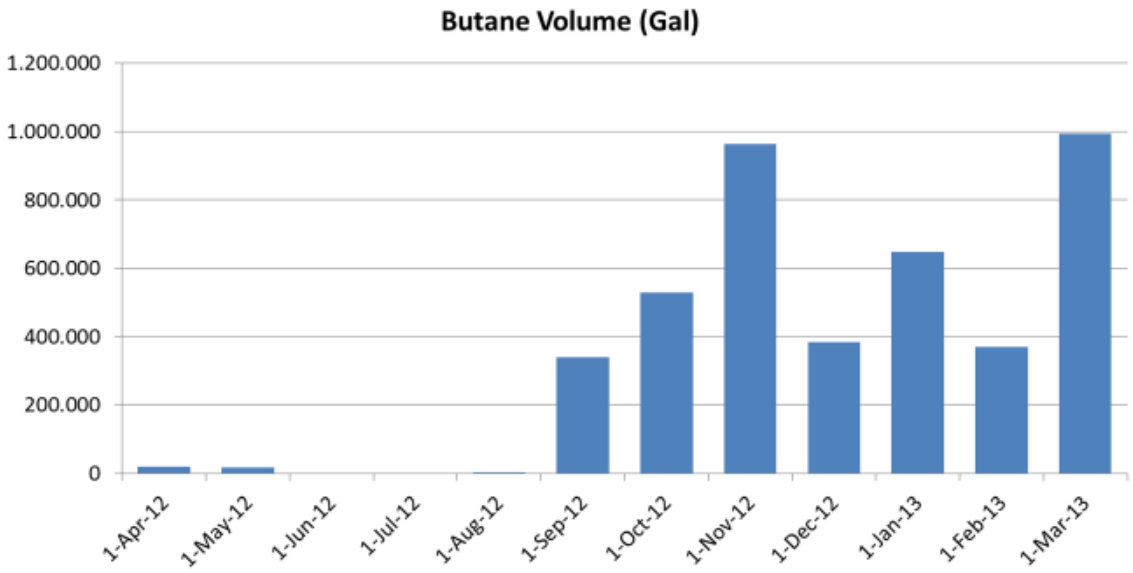
RFG = (reformulated) gasoline

Example: Milwaukee (US)



- Blending ~ **2.6 million Gallons Butane** in 6 months (Oct. 12 – Mar. 13)
- At a spread of $1.50, an extra profit of **$4 million** is possible
- An average 4.8% Butane were blended per month

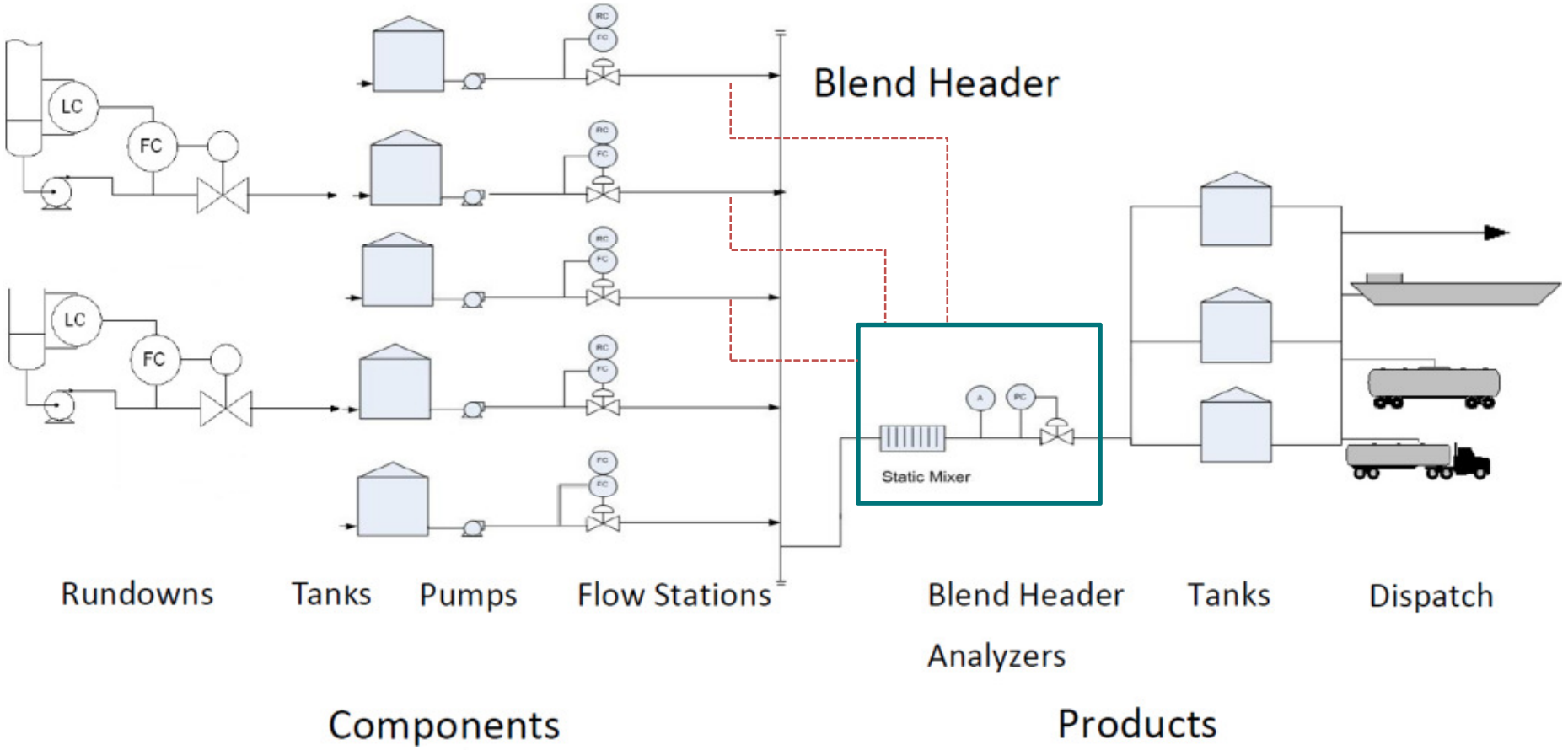
Example: Green Bay (US)



- Blending ~ **4.3 million Gallons Butane** in 12 months (Apr. 12 – Mar. 13)
- At a spread of $1.50, an extra profit of **$6.5 million** is possible
- An average 4.3% Butane were blended per month
- Blending focus is on wintertime, because higher vapor pressure is accepted

3. EQUIPMENT

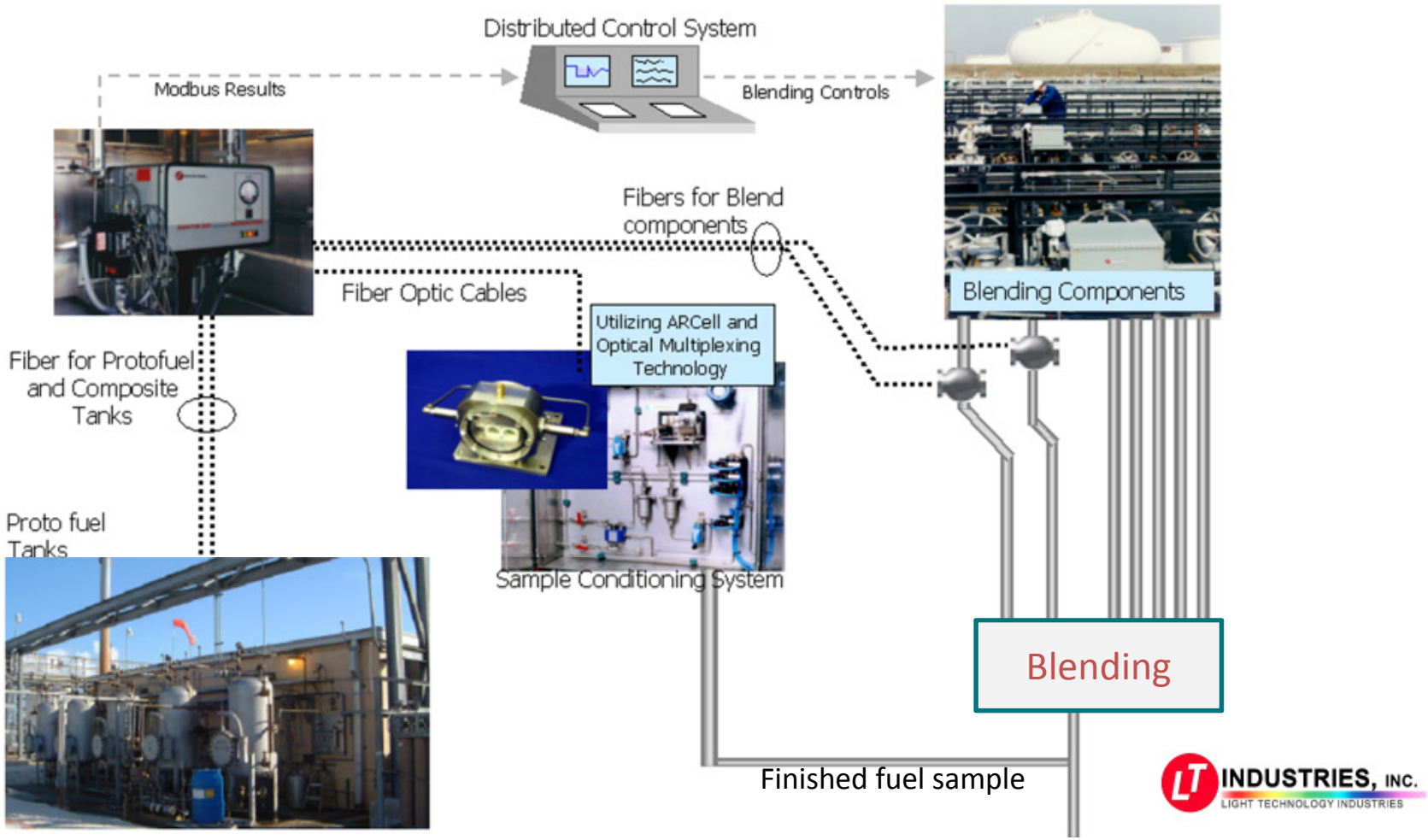
Online Blending Setup



Blending requirements

- Accurate FTIR process analyzer
- Accurate vapor pressure process analyzer
- Integrated into blending facility
- Blending gasoline supply
- Butane supply

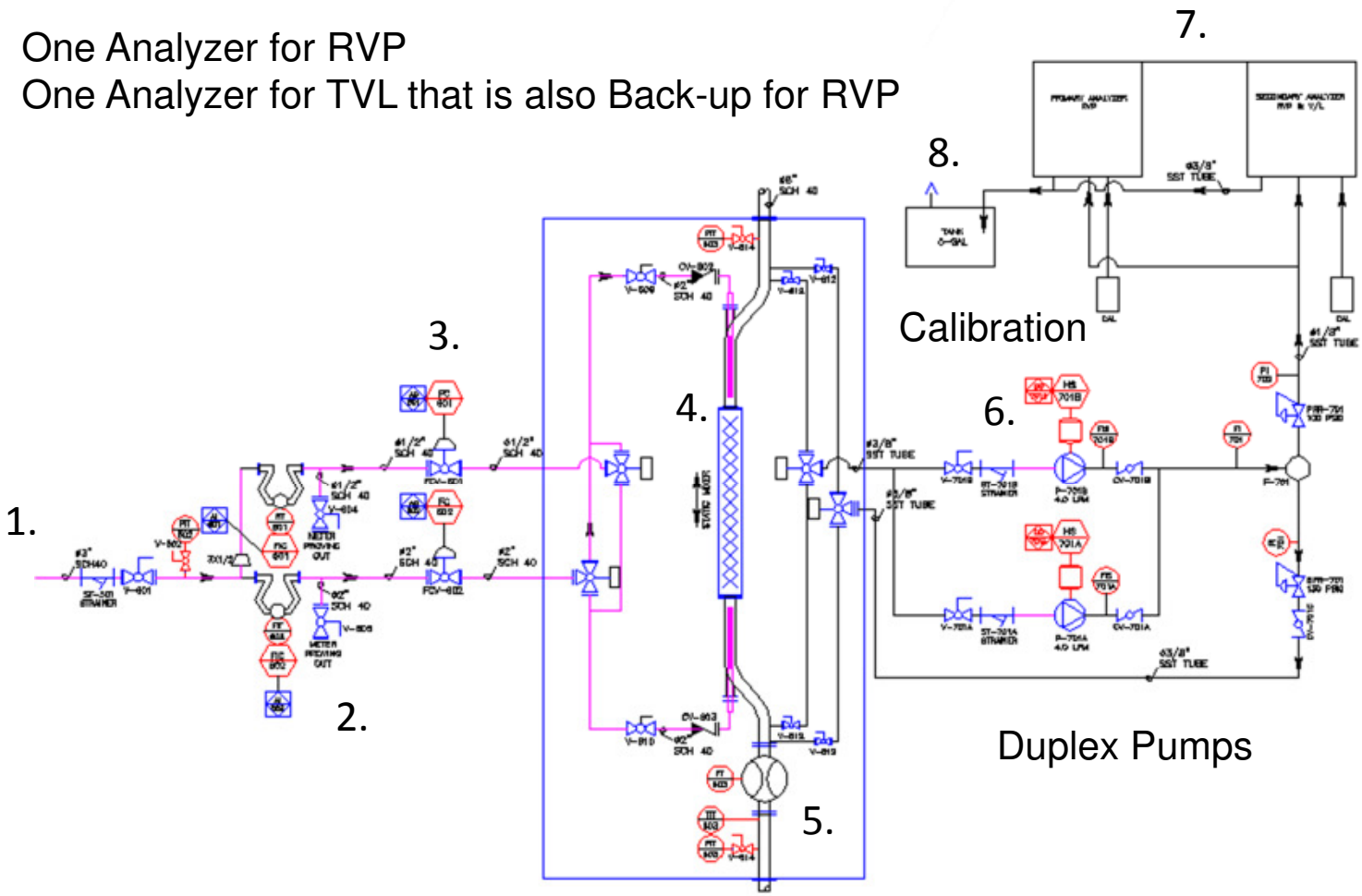
Typical FTIR System Configuration



LT INDUSTRIES, INC. LIGHT TECHNOLOGY INDUSTRIES

Butane Blending Process

One Analyzer for RVP
One Analyzer for TVL that is also Back-up for RVP



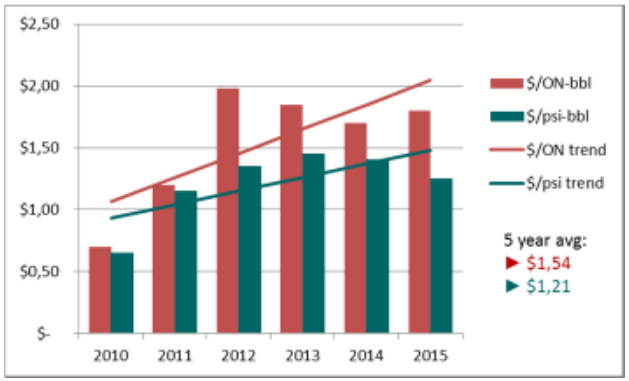
Butane Blending Key Requirements

- <u>On-Spec, Just in Time</u>
- Deliver homogenized blend
- High precision blend (± 0,2psi)
- High precision analyzers (± 0,1psi)
- Feedback loop to DCS
- Controlled butane flow (mass flow)
- Tight butane dosing (± 0,05%)
- Redundant configuration
  - Cross control
  - No down time

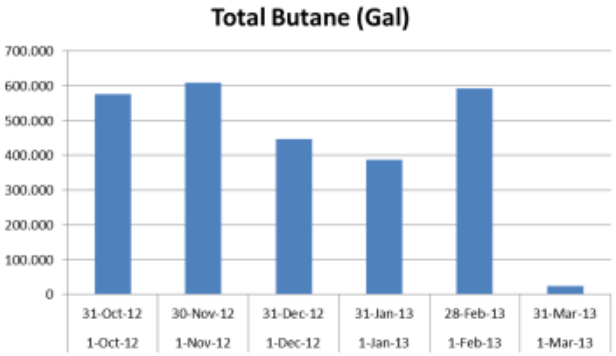
TECHNICS

Customers and References

Summary



- GIVE AWAY is lost potential profit
  - Described in ON-bbl and psi-bbl ($$$)
  - Premium gasoline sells higher than regular
  - Butane costs are lower than gasoline → MAKE MONEY
- BUTANE BLENDING
  - environmental and technical reasons for VP testing
  - optimizing refining profits through butane blending
  - Milwaukee makes $4M in six and Green Bay $6.5M in 12 months
  - higher precision = higher profit
- EQUIPMENT
  - Online Blending Tools
  - FTIR and VP Blending Setup



Further Reading …

- **D. Seiver**: „*Minimizing Gasoline Specification Give-Away*“,ptq Q4, pp. 31, 2015
- **Solomon & Associates**: „*North and South America Gasoline and Diesel Quality Analysis*“, 2010
- **D. Seiver, B. Stefurak**: „*Strategies for Achieving Optimal Gasoline Blending*“, Whitepaper (Valero&Honeywell), 2011
- **K. Crisafulli**: „*Inline Blending Can Help Process Plants Cut Costs and Reduce Quality Give-Away*“, ARC Advisory Group, blog, 2012
- **A. Munns**: „*Refinery Product Blending Optimization*“, Hydrocarbon Processing – IRPC, presentation, 2012
- **T. Edwards, H. Pichler**: „*Optimizing Profits by Blending Butane*“, ptq Q3, pp. 135, 2015

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