Wood to green gasoline using Carbona gasification and Topsoe TIGAS processes

RESEARCH | TECHNOLOGY | CATALYSTS

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Wood to green gasoline project

U.S. Department of Energy
Golden Field Office

DOE Award No.
DE-EE0002874

DOE Program Manager:
Paul Grabowski

Government share:
$ 25,000,000

Cost share:
$ 9,388,775

Period of performance:
12/28/09 through 12/31/14

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Acknowledgment & disclaimer

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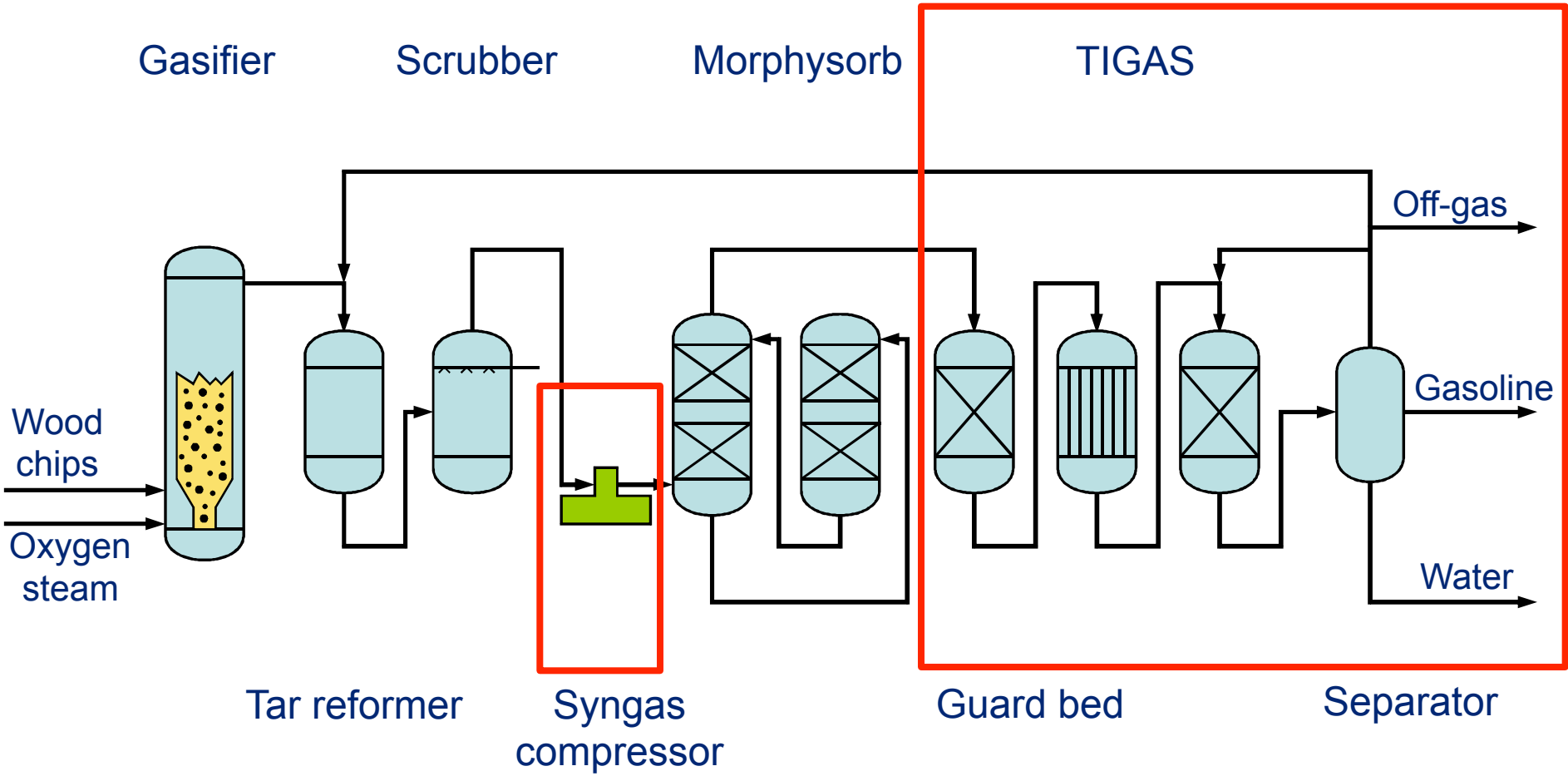
Niels Udengaard, Project Investigator, Haldor Topsoe Inc.
Jim Patel, Project Manager, Carbona/Andritz
Jesper H. Jensen, Project Manager, Haldor Topsoe A/S
Kip Walston, Project Manager, ConocoPhillips
Pekka Jokela, Project Manager, UPM-Kymmene

Process flow sheet of demonstration unit



TIGAS skid fabrication at Zeton

Construction at GTI – TIGAS module A1 lift

Test overview

Integrated TIGAS operation periods	
Shake-down (January 2013)	56 hours
	100 gal
Test #1 (March 2013)	47 hours
	573 gal
Test #2 (October 2013)	194 hours
	3954 gal
Test #3 (March 2014)	~ 194 hours
	~ 7000 gal
Total	500 hours

After initial mechanical start-up issues the TIGAS synthesis section of the demonstration plant operated very well at steady reactor temperature profiles

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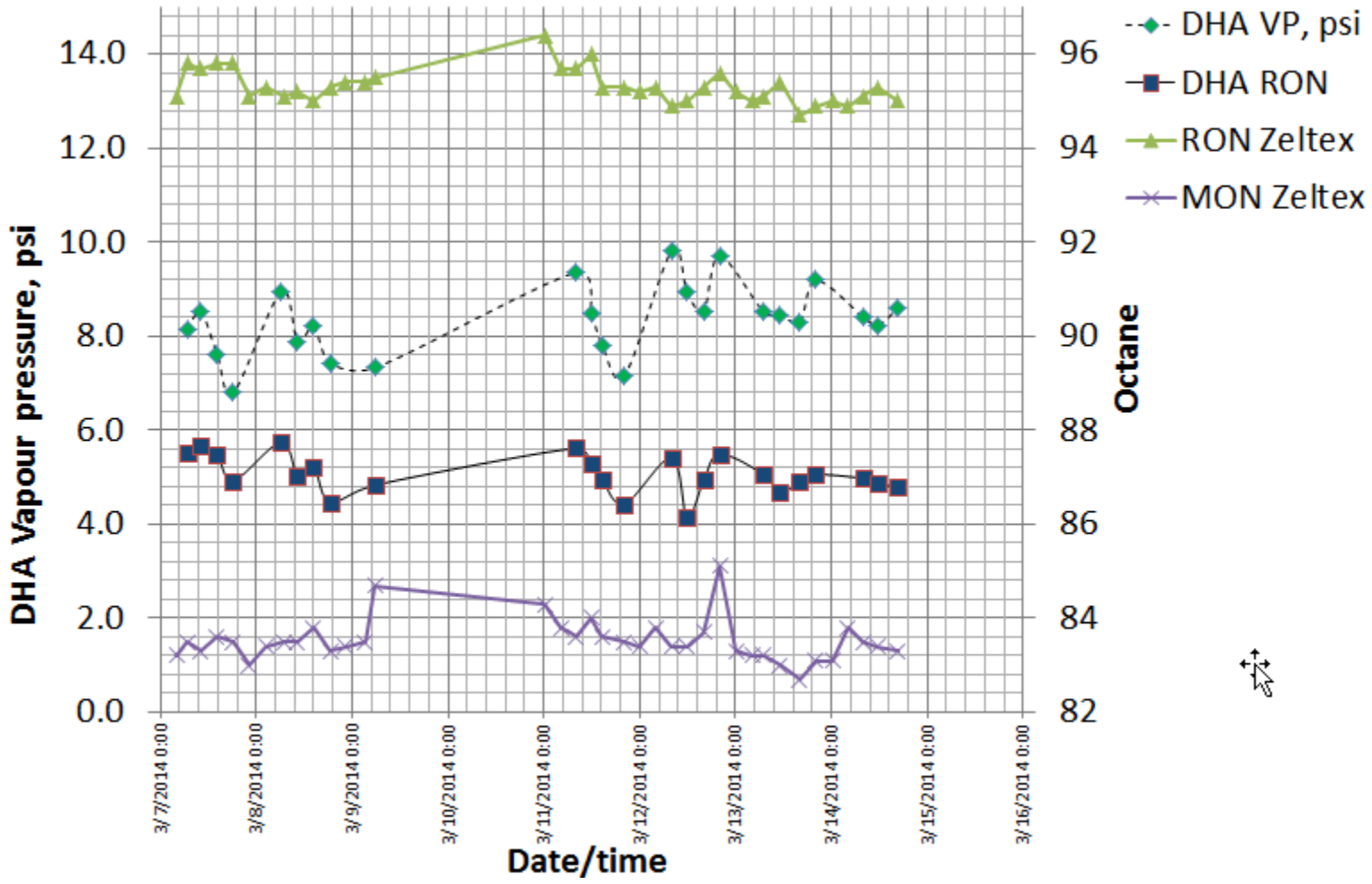
Test #3 Octane



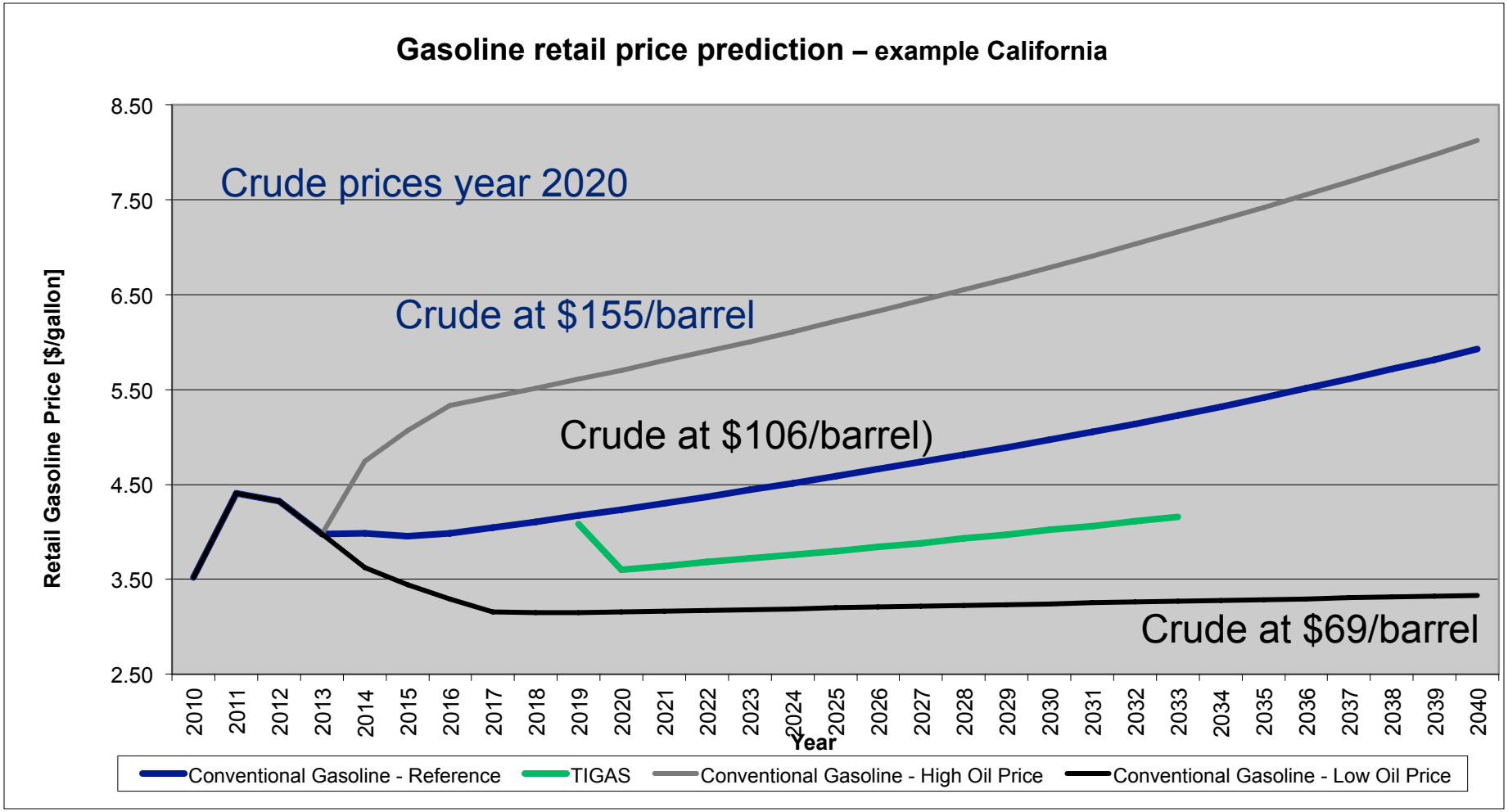
TIGAS gasoline testing

- Engine emissions testing at SwRI
  - Tested a 80/20 high biomass TIGAS/gasoline blend
  - Emission level ‘substancial similar’ to conventional gasoline
  - Phillips 66 will prepare EPA application for this blend
- Moderate Fleet Testing (planned for spring/ summer 2014)
  - 4 pairs of vehicles over ~ 4 months
  - Accumulate ~ 300,000 miles

NACE corrosion test

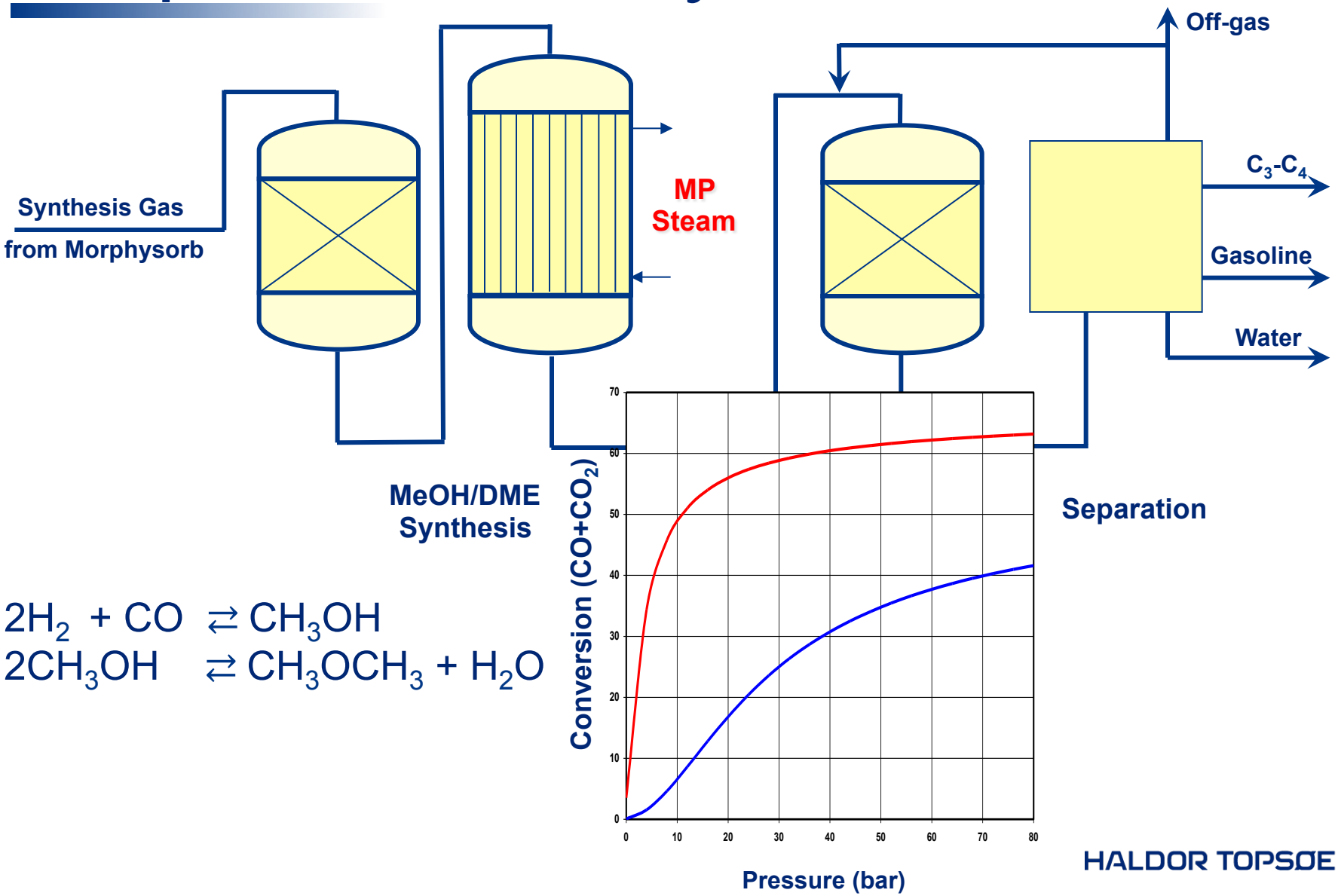
- Innospec Fuel Specialties performed corrosion evaluation of the raw TIGAS gasoline product using the NACE TM01-72 Corrosion Test.
- With a low treat rate of 2 ptb DCI-6A the raw TIGAS gasoline meets the typical Pipeline Specification of B+ (<5% corrosion).
- The actual test data showed much less corrosion corresponding to a B++ (<0.1% corrosion).
- A blend of the raw TIGAS gasoline and ethanol (E10 Blend) meets the B+ rating even before adding any corrosion inhibitors.

Project economics



Source: AEO2013 - Report Number DOE/EIA-0383(2013) http://www.eia.gov/forecasts/aeo/

Topsoe TIGAS synthesis



$2H_2 + CO \rightleftarrows CH_3OH$

$2CH_3OH \rightleftarrows CH_3OCH_3 + H_2O$

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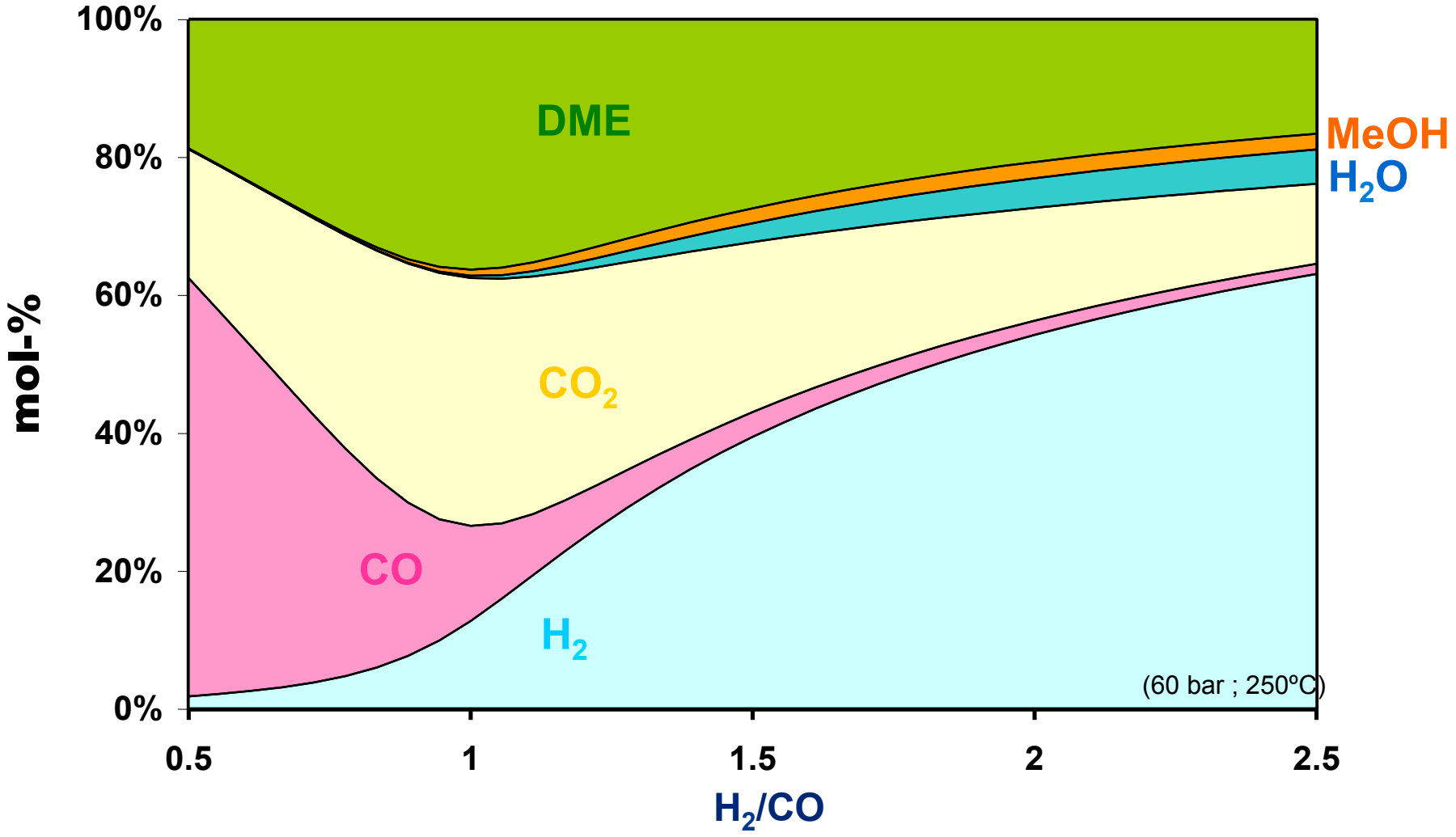
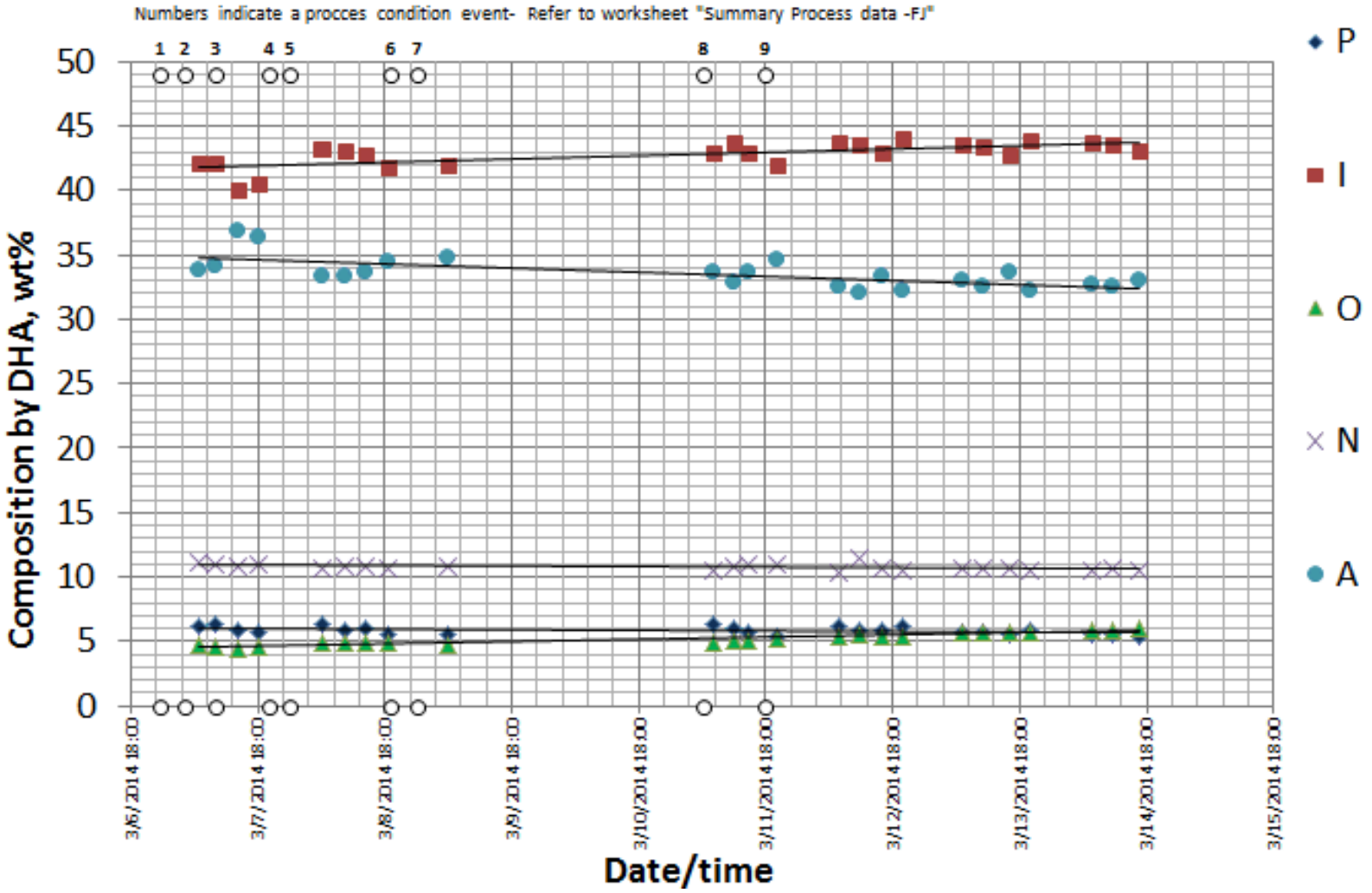
Topsoe TIGAS synthesis



Test #3 PINAO


Numbers indicate a procces condition event- Refer to worksheet "Summary Process data -FJ"
1 2 3 4 5 6 7 8 9
Composition by DHA, wt%
50
45
40
35
30
25
20
15
10
5
0
3/6/2014 18:00
3/7/2014 18:00
3/8/2014 18:00
3/9/2014 18:00
3/10/2014 18:00
3/11/2014 18:00
3/12/2014 18:00
3/13/2014 18:00
3/14/2014 18:00
3/15/2014 18:00
Date/time
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