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North Dakota Refining Capacity Feasibility Study

Energy Development and Transmission Committee 9/16/2010

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Introduction

Premise

- Independent study to determine feasibility for adding additional crude oil refining capacity in North Dakota
- Funding through Department of Energy
- Administered by NDAREC
- Two Phases

Team

- Corval Group
- Purvin & Gertz (PGI)
- Mustang Engineering

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Refining Capacity Feasibility Study

Phase I – 100,000 b/d, 50,000 b/d, 20,000 b/d

Marketing Study

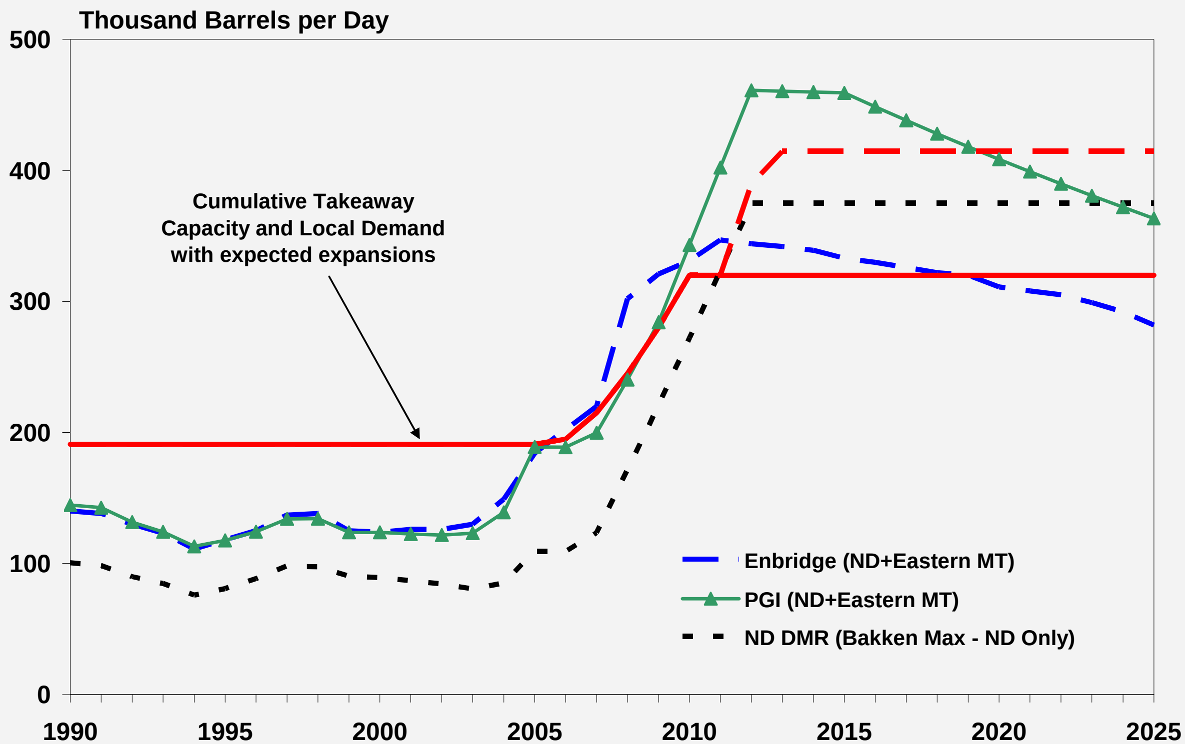
- Transportation analysis (crude and refined product)
- Refined Product pricing (capacity is key factor)

Crude Oil

- Availability and Pricing forecasts

Partnerships

Production – Williston Basin



- High potential for continued growth of supply

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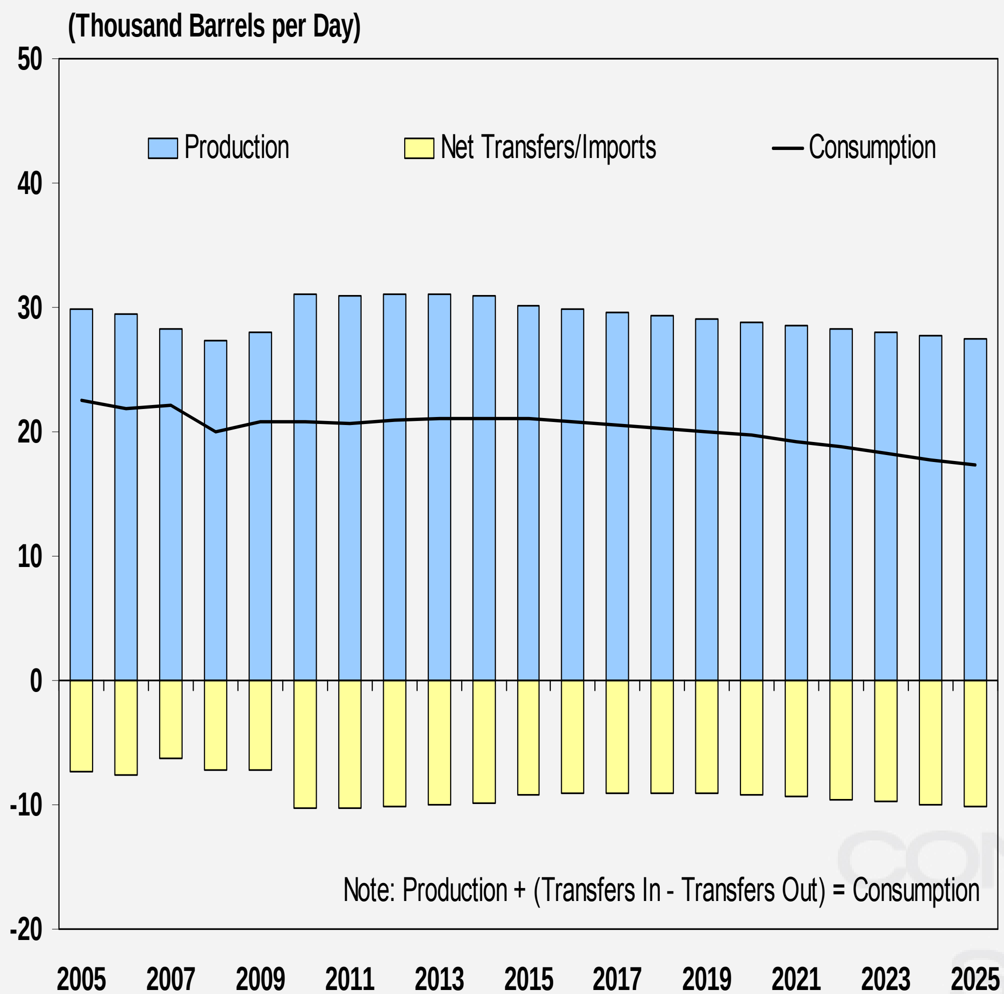
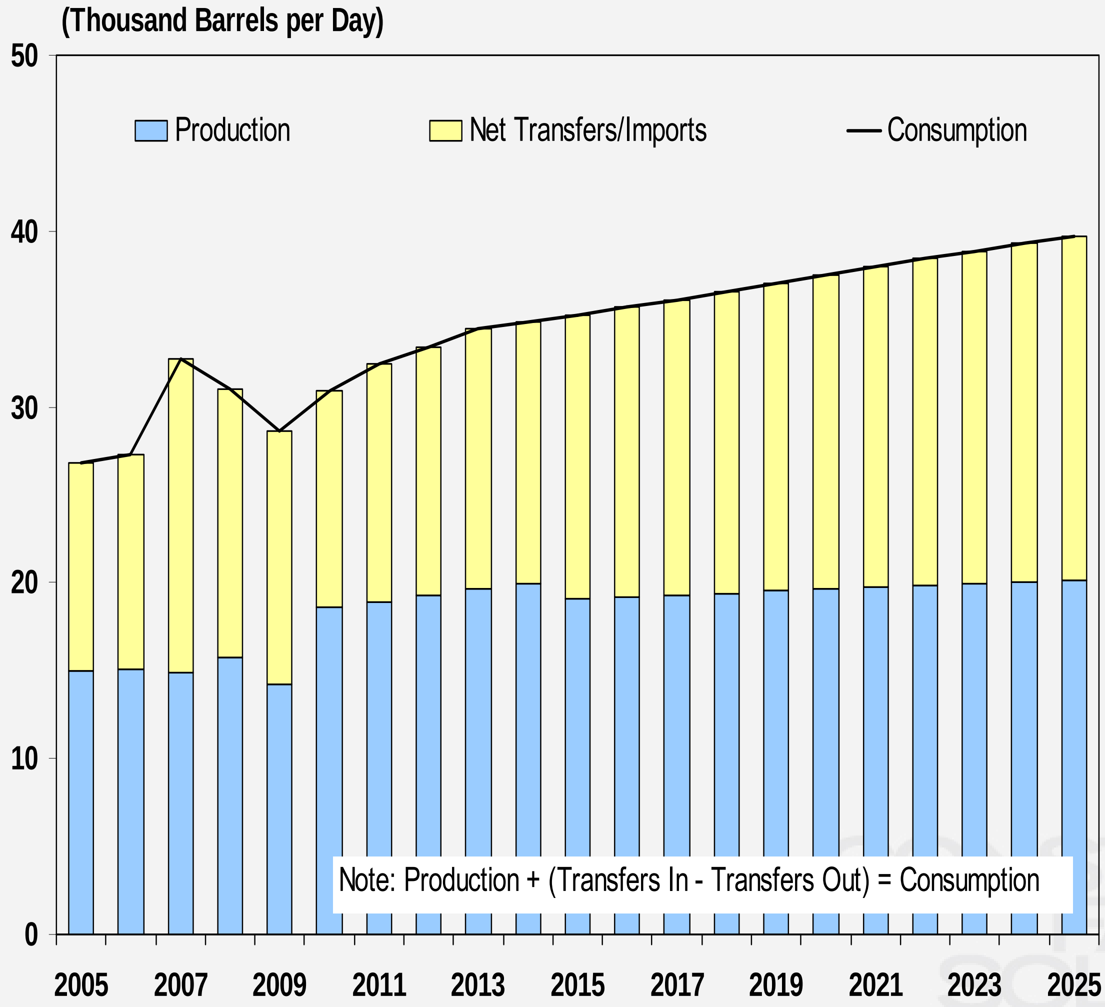
North Dakota Gasoline Balance



- Product transfers are essential to North Dakota's refined product balance
  - The market balances on net transfers out of the state

North Dakota Diesel Balance



- The diesel market relies on increasing net transfers into North Dakota.

Phase II Goals

- Identify the most feasible alternative for increasing the refining capacity in North Dakota
- Recommend a refinery configuration, estimate the capital cost, develop schedules, predict financial returns and perform a sensitivity analysis.
- Develop plot plans, emissions estimates and site selection requirements.
- Macroeconomics, regulations
- Barriers and Incentives to enhance project economics

Phase II (cont)

- Phase II was authorized with a modified scope of study.
- 20,000 BPD case was selected in place of the 100,000 BPD case due to lower market impact
- An alternate case was developed that maximized diesel fuel production to meet the market need in North Dakota.
  - The alternate case eliminated the production of gasoline in favor of naphtha, eliminating the capital investment required to make gasoline in a market where current supply exceeds demand.

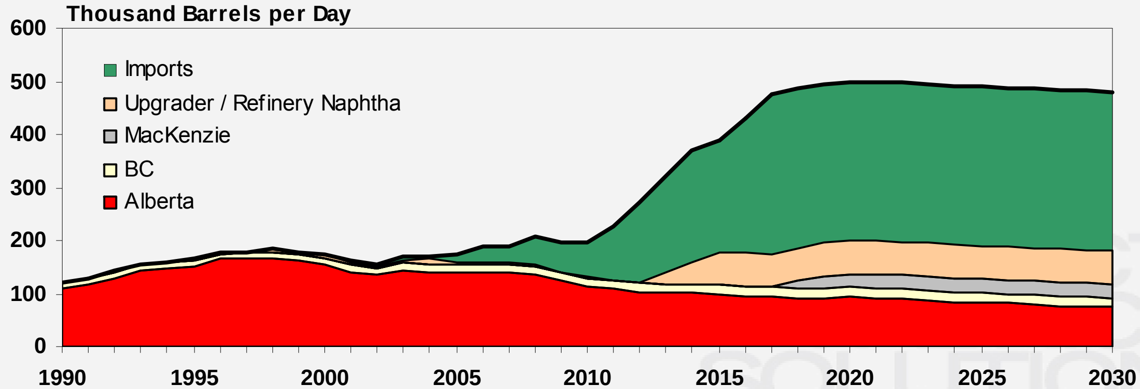
Phase II Configurations

- 20,000 BPD Case
  - Integrated refinery producing full slate of products
  - Numerous process units
    - Crude/Vacuum
    - Kero/Diesel Hydrotreating
    - Hydrocracker
    - Naphtha Hydrotreating
    - Naphtha Reformer
    - Light Naphtha Isomerization
    - Benzene Saturation
- 34,000 BPD Diesel / Naphtha Case
  - Diesel product focused, limited process units
    - Crude/Vacuum
    - Kero/Diesel Hydrotreating
    - Hydrocracker

Market Review-Canadian Naphtha/Diluent

- Naphtha is used as a diluent for pipelining Bitumen (heavy crude).
- Growth in the Canadian bitumen production has created a demand for naphtha.
- Canadian import of hydrocarbon streams such as naphtha is the most expedient short term option for increasing the supply of diluent to meet the demand created by the growth in bitumen production.

FIGURE 3
CONDENSATE AND NAPHTHA SUPPLY



LP Modeling Yields

	20 KBPD Refinery	34 KBPD Refinery
Charge and Yield		
Crude Charge		
North Dakota Sweet	20.0	33.9
Other Feedstocks		
Ethanol	0.8	0.0
Total Feedstocks	20.8	33.9
Liquid Yields		
LPG	1.3	1.1
Naphtha	0.0	15.0
Gasoline	8.7	0.0
Kerosene	1.0	1.5
Gasoil/Diesel	9.5	16.0
Fuel Oil (1% S)	1.0	2.0
Total	21.5	35.5
Other Yields		
Sulfur (ltpd)	3.6	6.2
Major Unit Capacities		
Crude	21.0	35.7
Vacuum	5.6	9.4
VGO Hydrocracker	6.2	10.6
Isomerization Unit	3.1	
Semi-Regen Reformer	5.6	
Naphtha Hydrotreating	8.7	
Kero/Diesel Hydrotreating	7.4	12.6
Bensat Unit	0.4	
Hydrogen Production (MMCFD)	7.3	20.7
Sulfur Recovery (LTD)	6.0	10.4

- 20KBPD
  - Gasoline, jet and diesel yield is 92.3% of refinery charge.
- 34KBPD
  - Jet and diesel yield is 51.6% of refinery charge.
  - The full production of naphtha (combined light and heavy) is assumed to be sent to Canada by rail.

Capital Cost Analysis

NORTH DAKOTA REFINERY STUDY
CAPITAL COST ESTIMATE
($ millions)

	20 KBPD Refinery	34 KBPD Refinery
Direct Construction Costs		
Inside Battery Limits (ISBL)		
Crude	$ 32.5	$ 49.5
Vacuum	$ 13.8	$ 20.6
VGO Hydrocracker	$ 86.7	$ 126.7
Isomerization Unit	$ 30.5	
Semi-Regen Reformer	$ 35.6	
Naphtha Hydrotreating	$ 35.7	
Kero/Diesel Hydrotreating	$ 43.4	$ 43.0
Bensat Unit	$ 7.0	
Light Ends Recovery	$ 3.4	$ 3.8
Hydrogen Production	$ 24.7	$ 47.2
Sulfur Recovery	$ 9.4	$ 13.6
Total ISBL Costs	$ 322.8	$ 304.4
Outside Battery Limits (OSBL)[1]	$ 150.2	$ 193.0
License and Engineering Fees	$ 15.4	$ 10.3
Initial Catalyst Fills	$ 4.7	$ 5.2
Total Direct Costs	$ 493.0	$ 512.9
Indirect Construction Costs		
Owner's Costs (15% ISBL+OSBL)	$ 70.9	$ 77.5
Contingency (15% Direct+Owner's)	$ 84.6	$ 91.4
Total Indirect Costs	$ 155.5	$ 168.9
Total Capital Costs	$ 648.5	$ 700.9

[1] OSBL costs include tankage, product loading facilities, utilities, buildings and other infrastructure

- Accuracy 40%
- Location factor estimated at 1.15 versus USGC.
- Owners costs (spare parts, permitting, land, management, studies, etc.) are estimated to be 15%.
- Contingency estimated to be 15%.

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Operating Cost Analysis

	20 KBPD Refinery	34 KBPD Refinery
Fixed		
Maintenance (incl. T/A + Labor)	11.6	13.3
Labor (except Maintenance)	17.6	14.8
Taxes and Insurance	3.5	3.9
Other	6.1	6.6
Total Fixed Costs	38.9	38.5
Total Fixed Costs ($/bbl Crude)	$5.33	$3.12
Variable		
Fuel	11.3	19.7
Electricity	2.2	2.3
Make-up Water	1.1	1.5
Catalyst and Chemicals	1.2	1.3
Total Variable Costs	15.8	24.7
Total Variable Costs ($/bbl Crude)	$2.16	$2.00
Total Operating Costs	54.7	63.3
Total Operating Costs ($/bbl Crude)	$7.49	$5.11

- Larger refinery has fixed cost economies of scale.
- Variable costs in the 20 KBPD case are higher per barrel due to the increased complexity.
- Operating Cost for both cases are higher per barrel than typical large USGC refineries.

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Project Schedule Analysis

- Three milestone schedules: best, probable and worst case cases.
- Critical factors for probable case are:
  - Organization and commercial development completed during 1Q 2011
  - Funding for initial engineering (FEL) activities available by Jan. 1, 2011
  - Time between finish of FEED and selection of EPC contractor is 4 months
  - Construction period 16 months
  - Probable case completion – 4^{th} Qtr. 2015

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Taxes and Depreciation

- Taxes:
  - 5 year property tax exemption.
  - 5 year income tax exemption.
  - 35% federal and 6.4 % state tax rates
  - Sales Tax exemption on the equipment, materials and tangible property for the initial construction was not included.

- Depreciation
  - MACRS (Modified Accelerated Cost Recovery System) – double declining balance over 10 years.

Cash Flow Results

- Internal Rate of Return and IRR Result
  - Real returns are discounted to 2010 dollars.
  - Nominal returns are not discounted.
  - All cash flows are on unleveraged basis.
  - 20,000 BPD Results
    - Real IRR 1.6%, Nominal IRR 3.7%
  - 34,000 BPD Results
    - Real IRR 7%, Nominal IRR 9.2%

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Final Phase – Next Tasks

- Plot plan of the refinery
- Utility balances
- Emissions estimates
- Site selection requirements
- Barriers and incentives that could enhance the project
- Benefits to North Dakota
- Final Report – Present early October