Minutes of the

EMPOWER NORTH DAKOTA COMMISSION

June 5th & 6th, 2014
Northern Great Plains Research Laboratory
1701 10th Avenue SW
Mandan, ND 58554

Day 1 of 2

Members present:
Al Anderson, Ron Ness, Dale Niezwaag, Mark Nisbet, Mike Rud, Randy Schneider, Jay Skabo, David Straley, John Weeda, Tyler Hamman proxy for Jason Bohrer.

Ex Officio Members:
Julie Voeck, proxy for John DiDonato
Wade Boeshans, proxy for Margaret Hodnik
Mark Bring, proxy for Chuck MacFarlane
Sandi Tabor

Others present:
Cal Thorson, NGPRL
Sandy McMerty, Department of Commerce
Justin Dever, Department of Commerce
Sherri Frieze, Department of Commerce
Mike Fladeland, Department of Commerce
John Mittleider, Department of Commerce
Paul, Lucy, Department of Commerce
Karlene Fine, Industrial Commission
Tanner Langley, North Dakota Petroleum Council.
Todd Kranda, Kelsch, Kelsch, Ruff & Kranda Law Firm
Vicky Steiner, NDAOGPC
Michelle Klose, ND State Water Commission
Kurt Swenson, Corval Group
Melissa Hochmuth, NextEra Energy
Justin Kringstad, North Dakota Pipeline Authority
Gaylon Baker, Stark Development Corp.
Andrea Stomberg, North Dakota Transmission Authority
Deana Wiese, North Dakota Ethanol Council
Shane Goettle, Odney Advertising
Dave Scharf, ONEOK
Danette Welsh, ONEOK
Carlee McLeod, Utility Shareholders of ND
Jay Hesse, Geronimo Energy
Don Boehm, Basin Electric
Mikhail Gurfinkel, Badlands NGLs
Gail Feeder, Clean Coal Solutions
Sam Larson, LLH Law Firm
Rand Linton, Green Fuels Energy

CALL TO ORDER/WELCOME

Chairman Anderson called the meeting to order at 10:00 a.m. and welcomed Commission members and guests.

APPROVAL OF MINUTES

A motion was made by Schneider and seconded by Ness to approve the minutes of May 1, 2014. Motion carried unanimously.

ND State Water Commission Report Current & Future Activities Michelle Klose

Michelle Klose, Assistant State Engineer of the ND State Water Commission discussed current and future expectations of water activities of the Missouri River system and Lake Sakakawea.

Klose mentioned that the State Water Commission deals with drinking water issues and not health quality issues of water. They also help with the development & permitting of water across the state.

Klose's presentation focused on these key areas:

- Western Area Water Supply Project
- Southwest Pipeline Project
- Northwest Area Water Supply Project
- Missouri River System Access issues
- Draft Cost-Share Policy
- 2013-2015 SWC Water Supply Approvals
- Missouri River System Access Issues
- Water Appropriation Challenges
- Protecting The Resource

Appendix A

Value-Added Market Opportunities for North Dakota
Natural Gas Liquids
Ethanol and Other Biochemical Derivatives
Don Bari& Ed Metzger

Don Bari began the presentation with the background of IHS, explanation of the Study Approach and Status of the Report. The Report was broken into 3 tiers; Commercial, Financial/Strategic, and Technology/Economic.

Bari discussed the feasible opportunities for the development of NGL based chemical derivatives for ND.

After his presentation, he took questions from the members.

What do you see as a competitive reaction from existing companies to new players and how will that affect a location in ND?

Bari responded: 1.) looking to capture the incremental demand in the US, 2) exports, 3) look for a company with customer relationship, partner with someone who is looking to expand their business. The North Dakota facility will most likely be owned by an existing petro-chemical company wanting to expand the business. They will base their decision on capturing incremental demand, including exports

Is water consumption a major factor for the plant?

Bari responded: Water is relatively on the small side, mostly in the cooling of the heating exchangers.

Edward Glatzer concluded the second half of the presentation with the discussion of Value-Added Ethanol Derivatives and Other Biochemicals.

Glatzer mentioned more incentives will be needed to bring in the producer, but ND has an advantageous geographic location relative to the U.S. Gulf Coast for supplying the markets, especially northern Midwest.

Appendix B

IHS was asked to come back in August to present to the Energy Development and Transmission Committee. Date is unknown at this time.

Energy Development and Transmission Committee meeting

Commissioner Anderson mentioned an electronic link of the Value-Added Study would be available for the EmPower members to access or it would be sent to them soon.

Legislative recommendations will need to be set by July.

Refined Coal

Gail Feeder, of Clean Coal Solutions, LLC, talked about refined coal and the coal beneficiation tax. Clean Coal Solutions is proposing a modification of coal beneficiation tax language for the 2015 legislative session. The intent would be to exempt coal conversion facilities owned and operated by third parties that reside within the "fence" of a Utility where the "beneficiated" coal is burned to generate electricity. Appendix C

Reports on Critical Policy Components:

Sandy McMerty, Commerce staff edited the 2012 Policy Updates and Recommendations Document with updates from the four key areas of: Infrastructure, Workforce, Research and Development, and Federal Regulatory Assessment.

Members discussed and reviewed each area for accuracy. Justin Dever helped to update the legislative action matrix.

ADJOURNMENT

The Chairman adjourned the meeting at 4:30 p.m.

Al Anderson Date
Chairman

Sherri Frieze Date
Recording Secretary

Day 2 of 2

Minutes of the

EMPOWER NORTH DAKOTA COMMISSION

June 6th, 2014
Northern Great Plains Research Laboratory
1701 10th Avenue SW
Mandan, ND 58554

Members present:
Al Anderson, Ron Ness, Dale Niezwaag, Mark Nisbet, Mike Rud, Randy Schneider, Jay Skabo, David Straley, John Weeda, Jason Bohrer

Ex Officio Members:
Julie Voeck, proxy for John DiDonato
Wade Boeshans, proxy for Margaret Hodnik
Mark Bring, proxy for Chuck MacFarlane
Sandi Tabor

Others present:
Cal Thorson, NGPRL
Sandy McMerty, Department of Commerce
Justin Dever, Department of Commerce
Sherri Frieze, Department of Commerce
Mike Fladeland, Department of Commerce
Danette Welsh, ONEOK
Carlee McLeod, USND
Warren Enyart, M-Power, LLC
Tyler Hamman, Lignite Energy Council
Karlene Fine, Industrial Commission
Cory Fong, Odney Advertising
Andrea Stomberg, NDTA

CALL TO ORDER/WELCOME

Chairman Anderson called the meeting to order at 8:30 a.m. and welcomed Commission members and guests.

Continued Reports on Critical Policy Components:

Sandy McMerty, Commerce staff continued editing the 2012 Policy Updates and Recommendations Document.

Sandy will revise the Policy Document, forward to the members for comments, and present the draft to the Commission during the July meeting for final approval.

ADJOURNMENT

The Chairman adjourned the meeting at 12:00 p.m.

Al Anderson Date
Chairman

Sherri Frieze Date
Recording Secretary

Michelle Klose – Assistant State Engineer

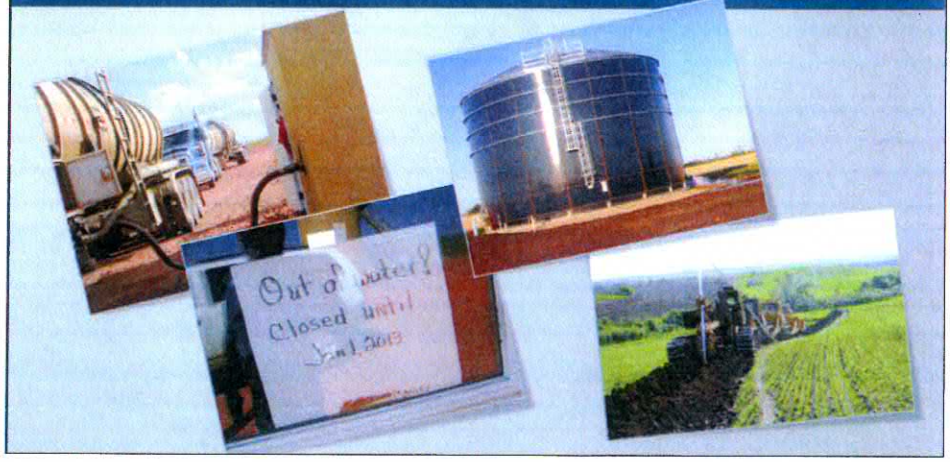
EmPower North Dakota Commission

North Dakota State Water Commission Report
Current & Future Activities

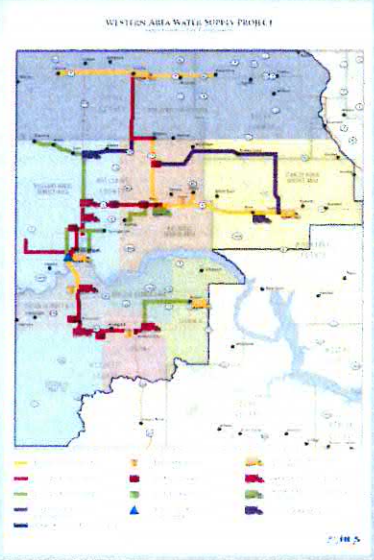
North Dakota
State Water Commission

June 5, 2014

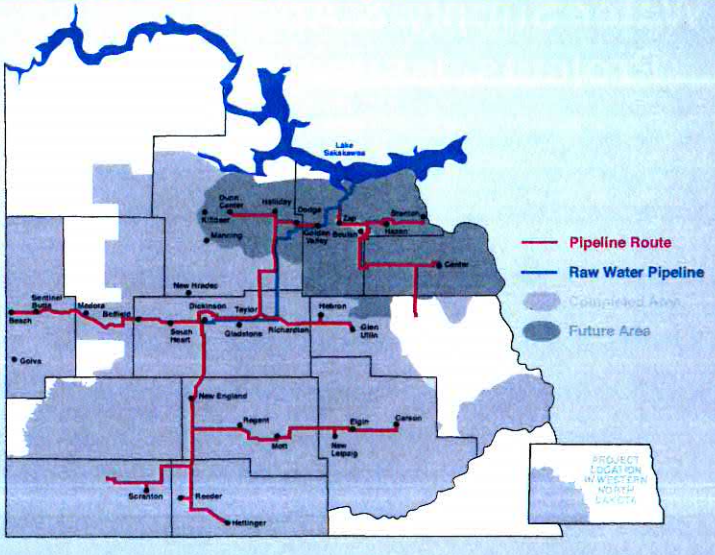
STATE WATER COMMISSION
Water Supply & Appropriation – Projects, Issues, Challenges



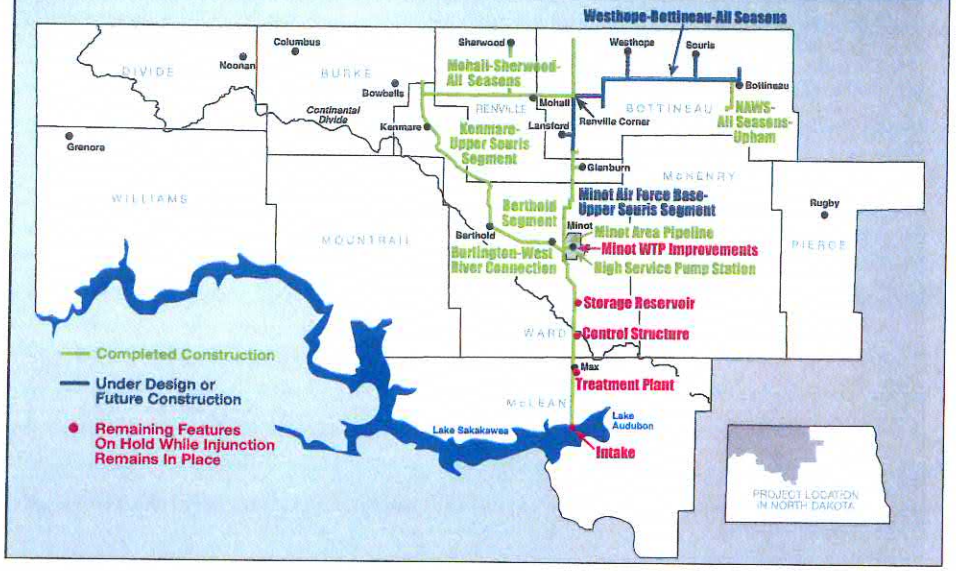
WAWS PROJECT



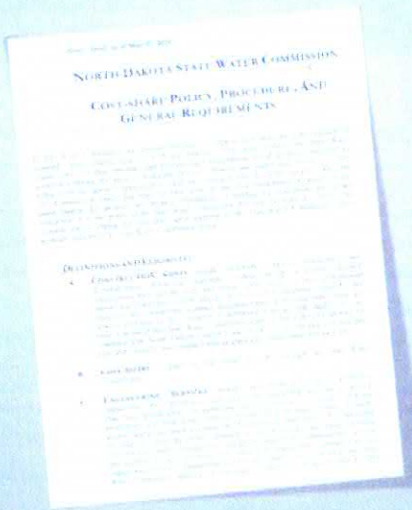
SWPP PROJECT



NAWS PROJECT

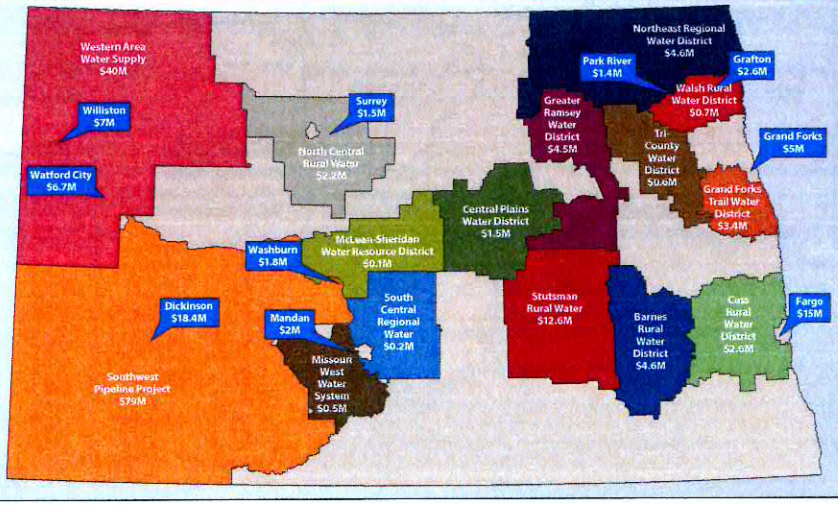


DRAFT COST-SHARE POLICY

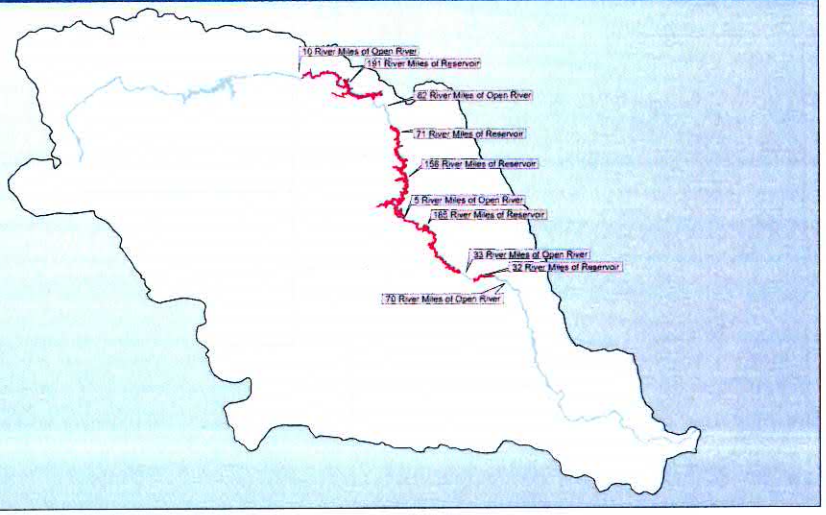

NORTH DAKOTA STATE WATER COMMISSION
COST-SHARE POLICY, PROCEDURES AND
GENERAL REQUIREMENTS

- Special Focus On Water Supply.
- Addresses Population Growth Areas.
- Connection Of Communities To Regional Systems – Expansions.
- Improved Opportunities For Loans.

2013-2015 SWC WATER SUPPLY APPROVALS (Through March 2014)



MISSOURI RIVER SYSTEM ACCESS ISSUES



MISSOURI RIVER SYSTEM ACCESS ISSUES

Missouri River at Lake Sakakawea Inflows and Outflows in 2013

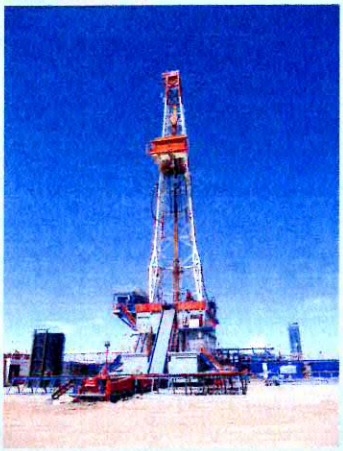
	Aver. Monthly Inflow (cfs)	Aver. Monthly Outflow (cfs)	Monthly Inflow (ac-ft)	Monthly Outflow (ac-ft)	Monthly Inflow-Outflow (ac-ft)
Jan	16,000	21,265	983,568	1,307,194	-323,626
Feb	18,821	22,857	1,045,041	1,269,120	-224,079
Mar	17,516	18,003	1,076,769	1,106,712	-29,943
Apr	23,767	18,977	1,413,879	1,128,922	284,957
May	25,871	20,155	1,590,366	1,238,978	351,388
Jun	51,667	19,867	3,073,650	1,181,868	1,891,782
Jul	21,000	19,152	1,290,933	1,177,307	113,626
Aug	14,968	19,226	920,112	1,181,868	-261,756
Sep	15,800	16,335	939,942	971,777	-31,835
Oct	17,774	13,029	1,092,633	800,934	291,699
Nov	13,200	13,183	785,268	784,277	991
Dec	12,258	15,848	753,540	974,238	-220,698
		Total =	14,965,701	13,123,195	

Total Releases =	-1,091,937
Total Captured =	2,934,443

MISSOURI RIVER SYSTEM ACCESS ISSUES

- Surplus Water Reports
- Reallocation Study
- Rulemaking

WATER APPROPRIATION CHALLENGES



- Increased Need For Permits To Serve Oil Industry.
- Hundreds Of Temporary Permit Requests Annually.
- Implementing Automated Tracking Of Industrial Water Use.

PROTECTING THE RESOURCE

- Implementing Strict Fines & Penalties For Water Theft & Over-usage.
- Criminal Penalty – Class A Misdemeanor.
- Civil Penalty - $25,000 Per Day.
- Overage Loss Following Year.
- Possible Permit Revocation.


Thank You
Michelle Klose
Assistant State Engineer
701.328.4959
maklose@nd.gov

Studies to Evaluate Value-Added Market Opportunities for North Dakota

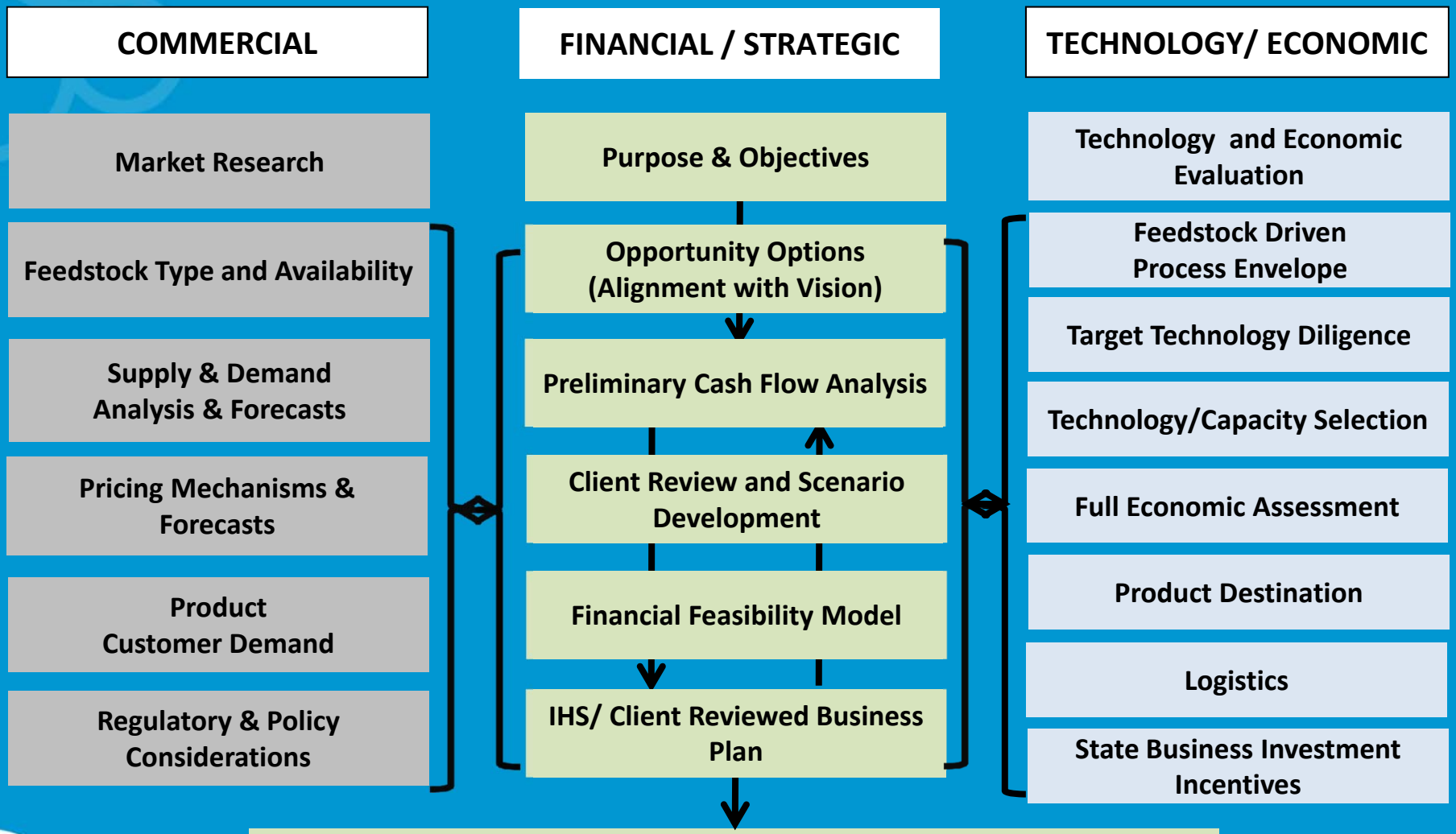
- ✓ Natural Gas Liquids (NGLs)
- ✓ Ethanol and Other Biochemical Derivatives

Don Bari, Vice President, Technology and Analytics Group
Edward Glatzer, Managing Director

June 5, 2014

Bismarck, North Dakota

The Study Approach and Status



Who is IHS?

- We are a public company (founded in the 1950s) and have a current revenue of over US $ 2 billion

- We help companies make informed decisions by providing independent:
  - industry insight
  - knowledge
  - data & analysis

IHS Has Substantial Industry Integration

We have 9000 staff in 30 countries

IHS Chemical

- **IHS Chemical brings together over 60 years of insight through 3 world-class legacy brands**

- **CMAI**
- **SRI Consulting**
- **Chemical Week**

We Think Value Chains: Vertically & Horizontally

Chemical industry development starts here

Oil, Gas Production

Hydrocarbon Feed

Monomer/Base Chemicals

Derivatives & Intermediates

Plastics & Rubber

Oil Refining and Gas Processing

Separation, Conversion

Conversion

Polymerization

Customers

Retail

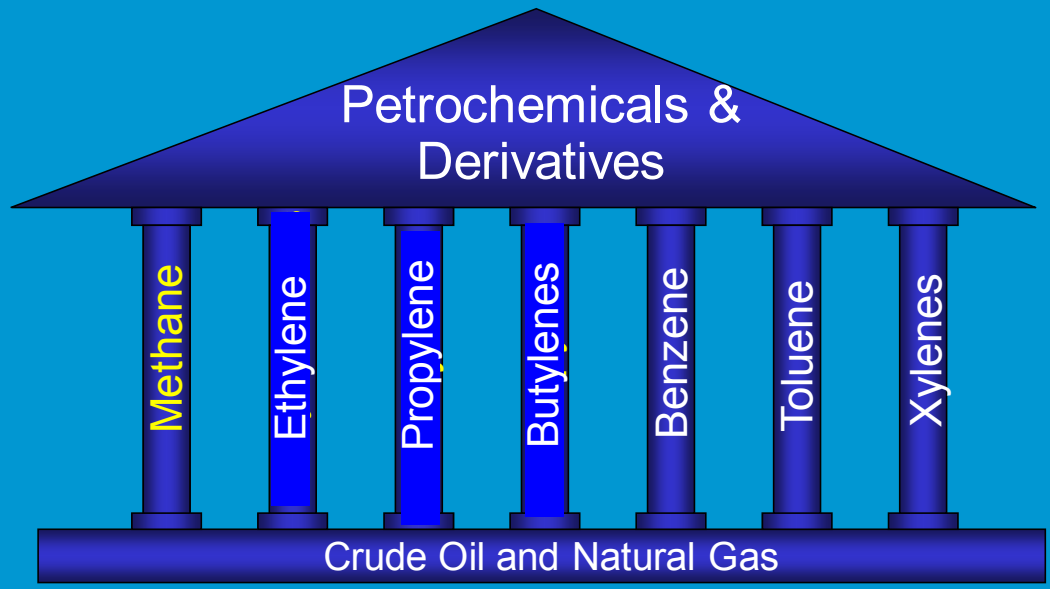
Manufactured Goods

Converters: Tires and Other Fabricated OEM Parts

The Fabricated Products are Diverse and Familiar

Petrochemical Building Block Chemicals

- Ethylene, propylene, butylenes, represent three of the seven basic "building blocks" in the global petrochemical industry
- NGLs (ethane, propane and butanes) are the raw material precursors to these building block chemicals

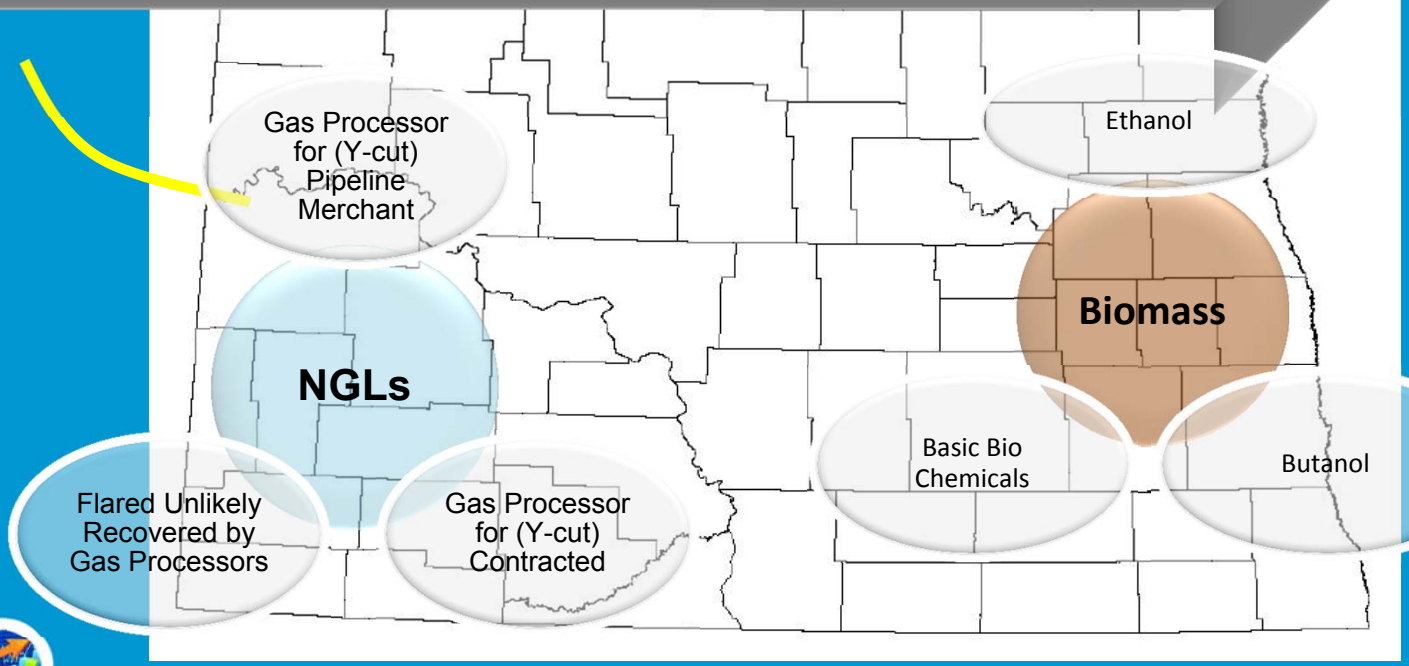


Most petrochemical derivatives can be traced back to one or more of these building blocks

The Feedstock-Product Value Chain

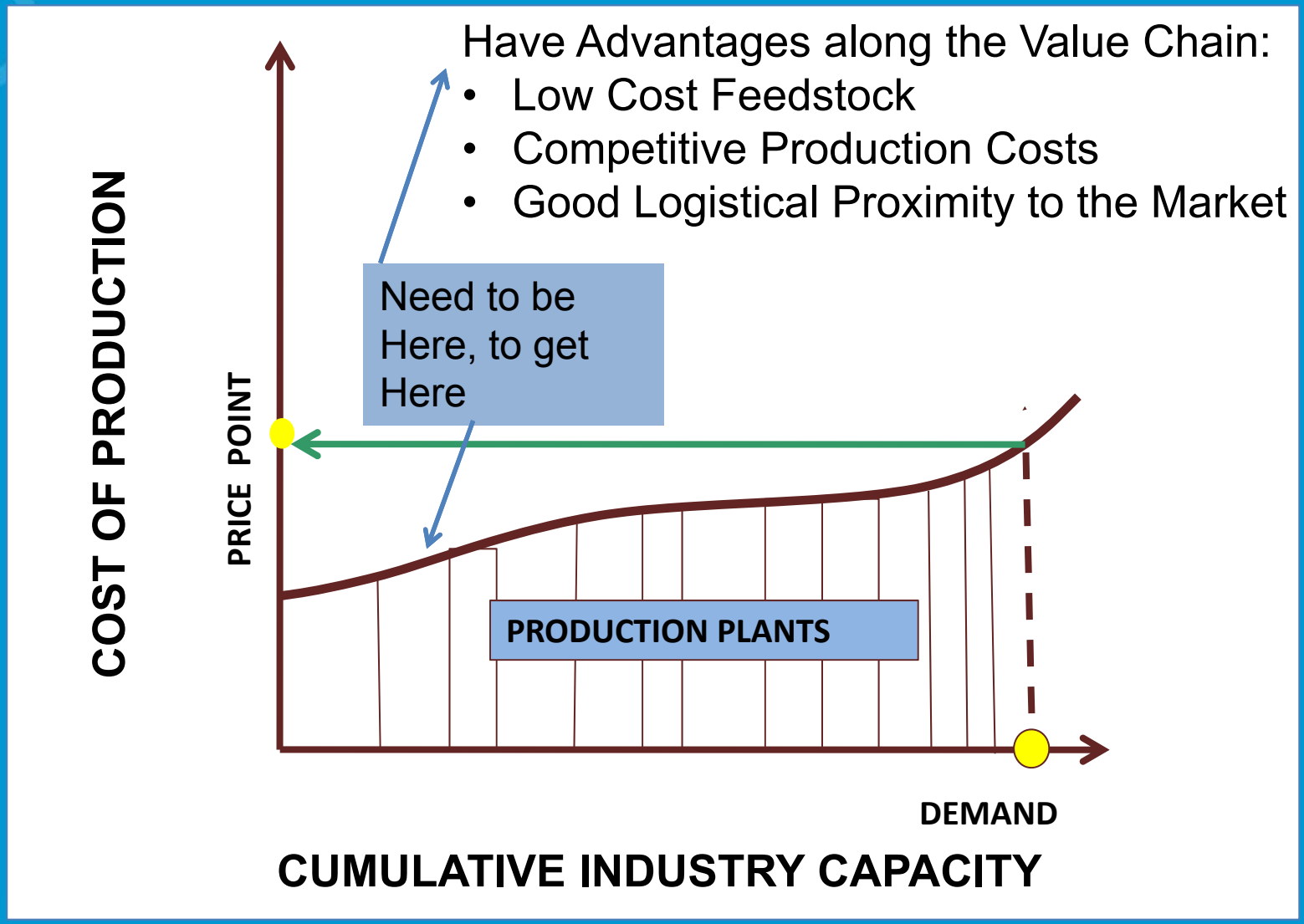
To be Advantaged here, You Need to be Advantaged here

Ethane, Propane, Butanes → **Intermediate Chemicals** → **Commodities Specialties** → **End-Use & Fabricated Products**

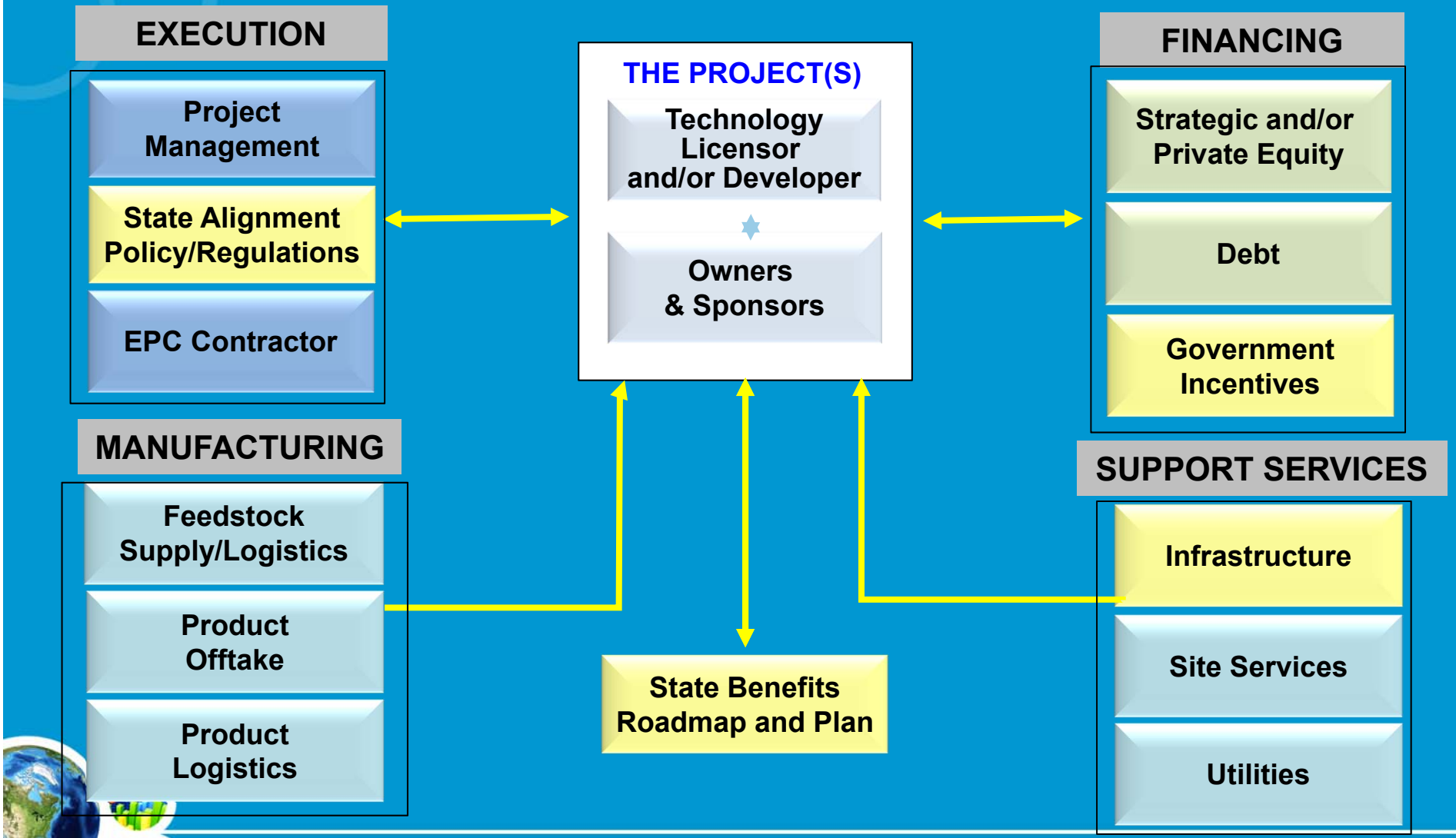


Bio-based Chemistry is More Complex

Fundamentally, the Industry Cost Curve Dictates Success



To Be Successful, Project Development Must "Execute" all the Fundamental Aspects



Adding Value to the Bakken NGLs

Why is there an Opportunity to Add Value to the Bakken's Hydrocarbons

Global Gas Demand (2013) 120 TCF

Methane
Ethane
(Fuel Gas)

92%

Ethane, Propane, Butane, Light Naphtha (NGL)

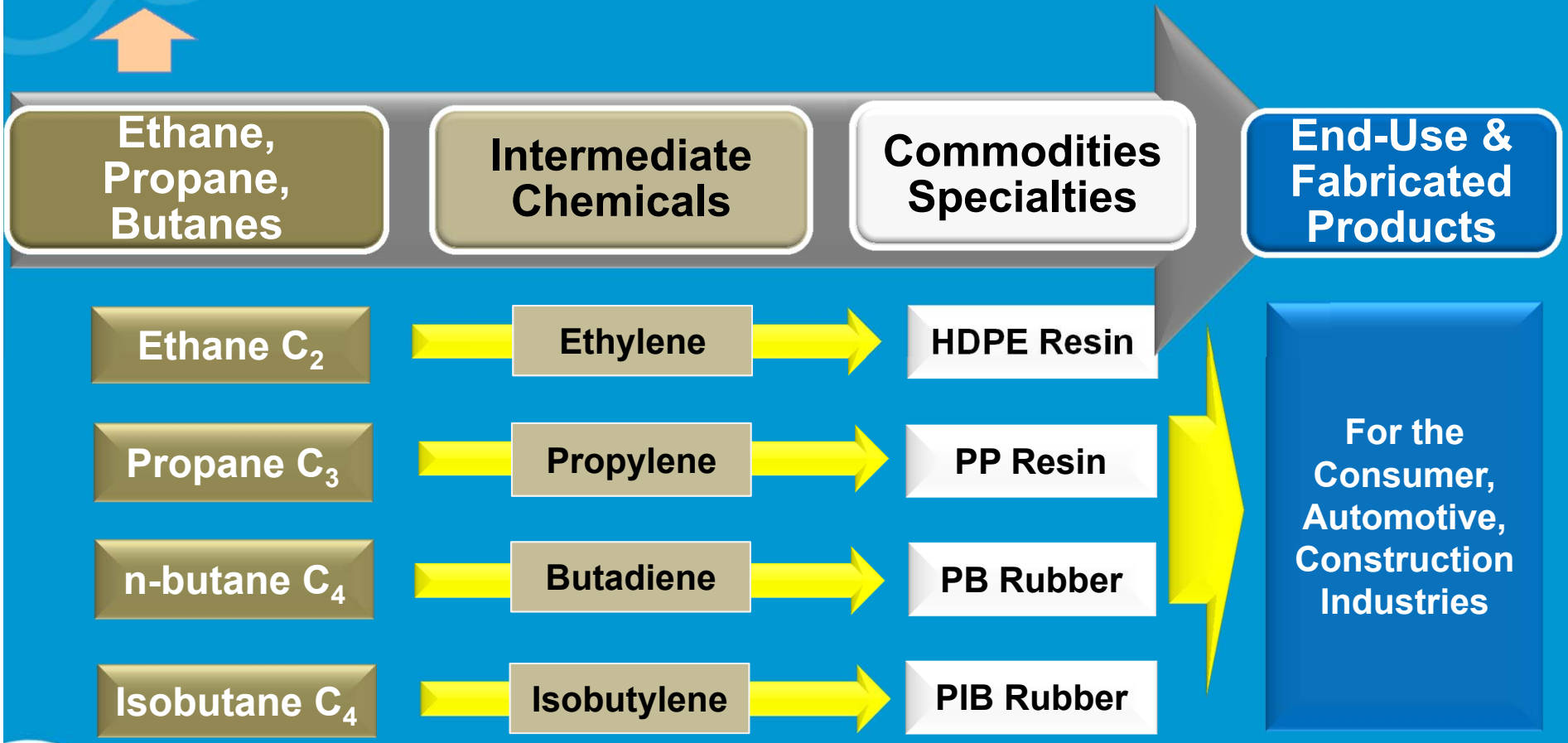
92%

Petrochemical Industry 25%

Oil, coal and methane- based feedstocks make up the rest

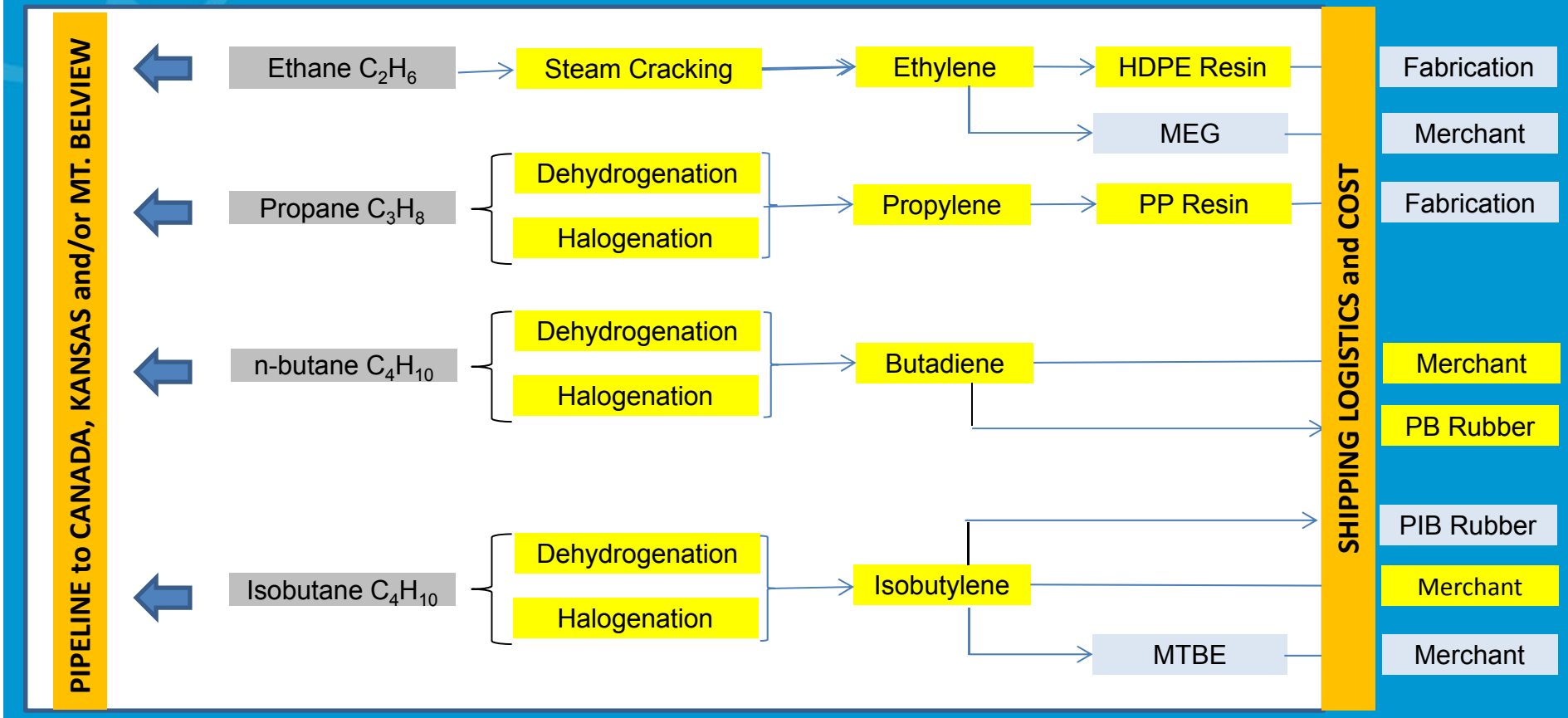
The Likely Value-Add Opportunities for the Bakken

Currently to Pipeline and Fuels



NGLs to Chemicals: Economic Screening

Indicates Opportunity

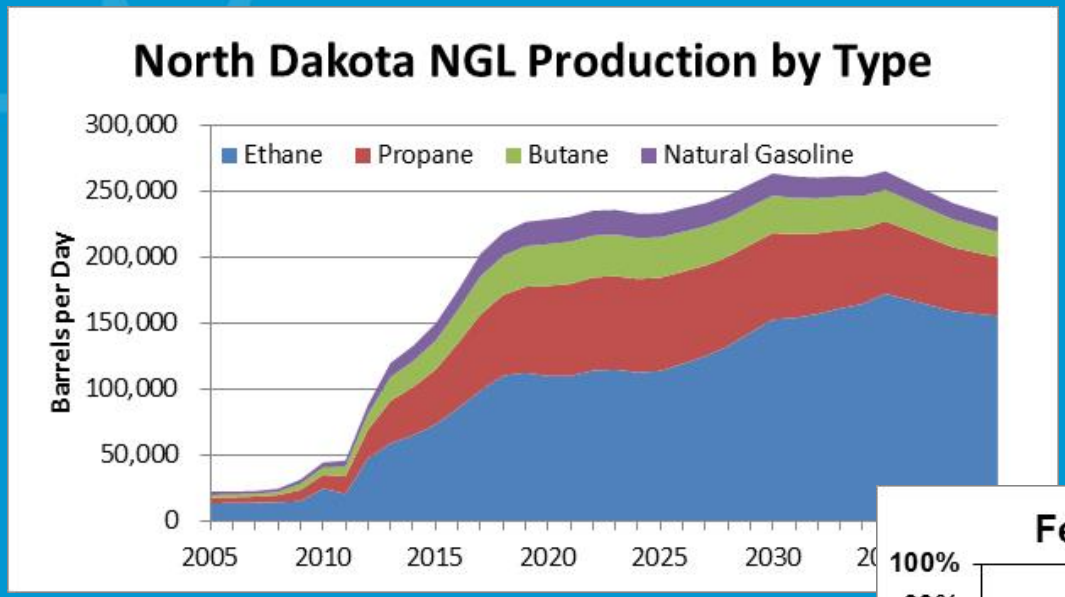


NGLs to Chemicals: Capacity and Capital Costs – North Dakota - 2020 Basis

NGL - Feed Requirements		
	KMT	Bbl/day
Ethane Feed - HDPE	520.90	27781
Ethane Feed - MEG	297.90	15888
Propane Feed - PDH	563.30	21166
Propane Feed - Halogenation	497.30	18686
n-Butane Feed - BDH	512.40	16769
n-Butane Feed - Halogenation	348.10	11392
i-butane - BDH	152.50	4852
i-butane - Halogenation	134.70	4286

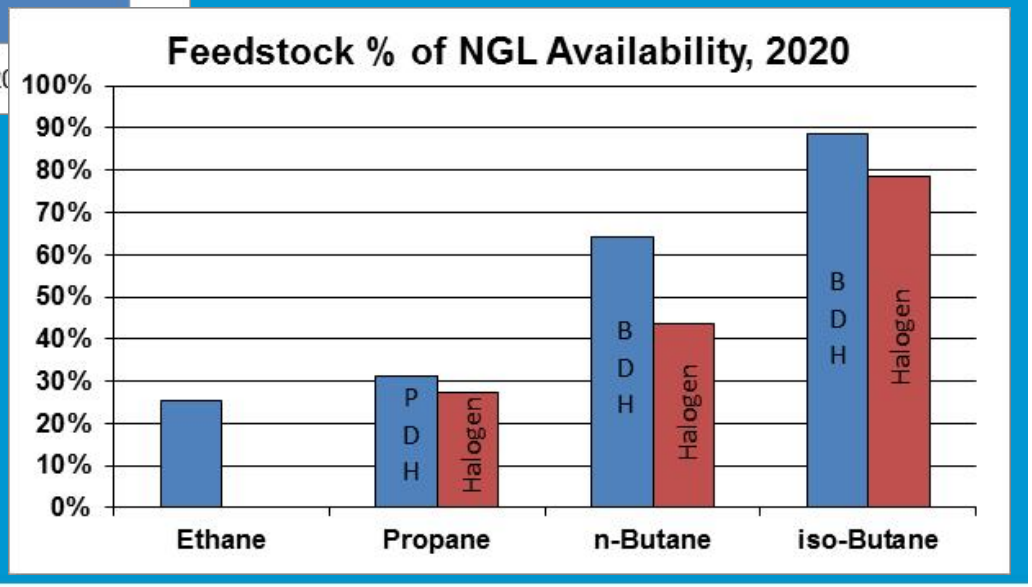
NGL		
	Capacity, kMT	Capital, USMM$
Ethane Cracker - HDPE	404.00	939.00
Ethane Cracker - MEG	231.00	635.00
HDPE	400.00	309.00
EO	304.00	727.00
MEG	400.00	197.00
Propane Dehydrogenation (PDH)	467.00	1191.00
Propane Halogenation	467.00	758.00
Polypropylene ICP	500.00	487.00
n-Butane Dehydrogenation (BDH)	300.00	1460.00
n-Butane Halogenation	336.00	491.00
Oxo-D	300.00	708.00
Polybutadiene (PBR)	100.00	286.00
Isobutane Dehydrogenation	130.00	247.00
Isobutane Halogenation	130.00	225.00
MTBE via Isobutylene	200.00	28.00

Bakken NGL is Expected to Provide an Advantaged Feedstock Position

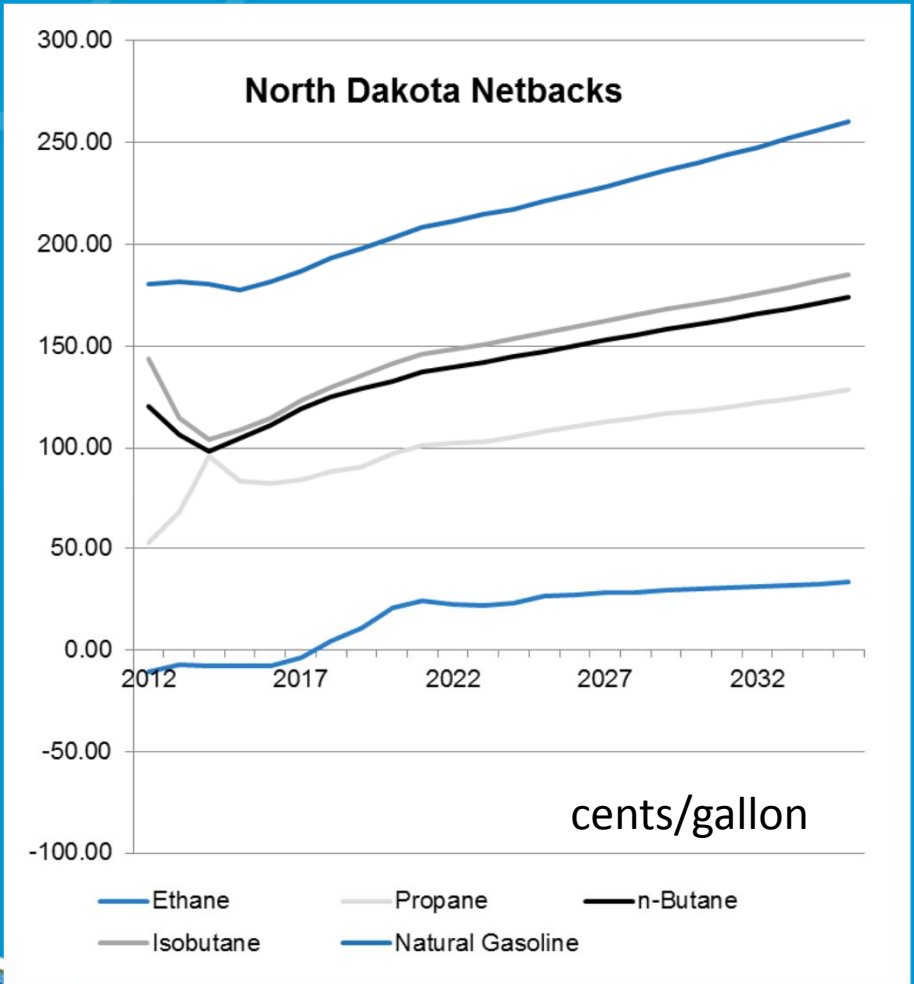


Even with IHS' conservative estimates, the availability situation for competitive-scale petrochemical plant is promising

NGL supply demand price outlook cases are forecast to give a Bakken-based NGLs a strong feedstock to derivative chemical plants



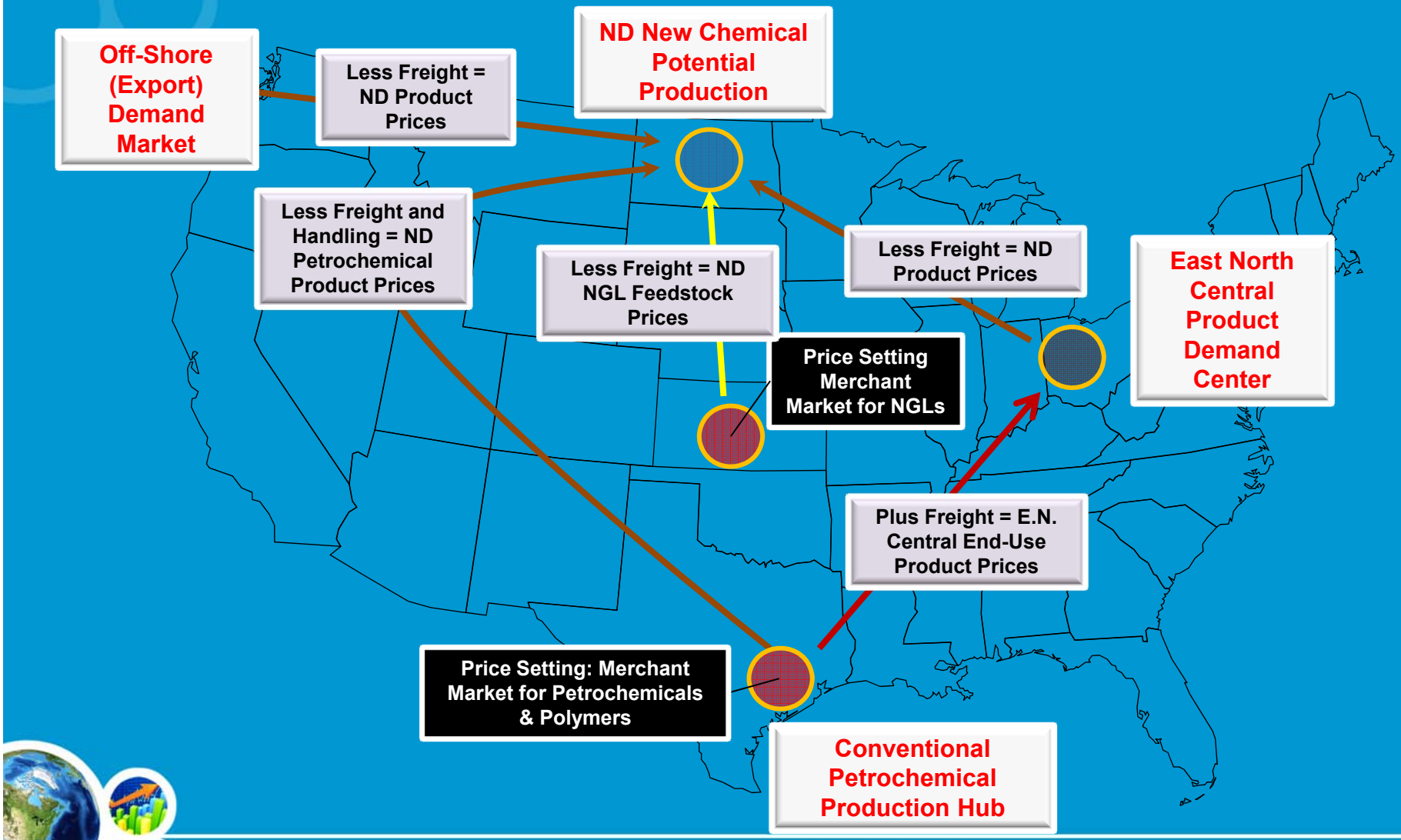
North Dakota Netback Prices



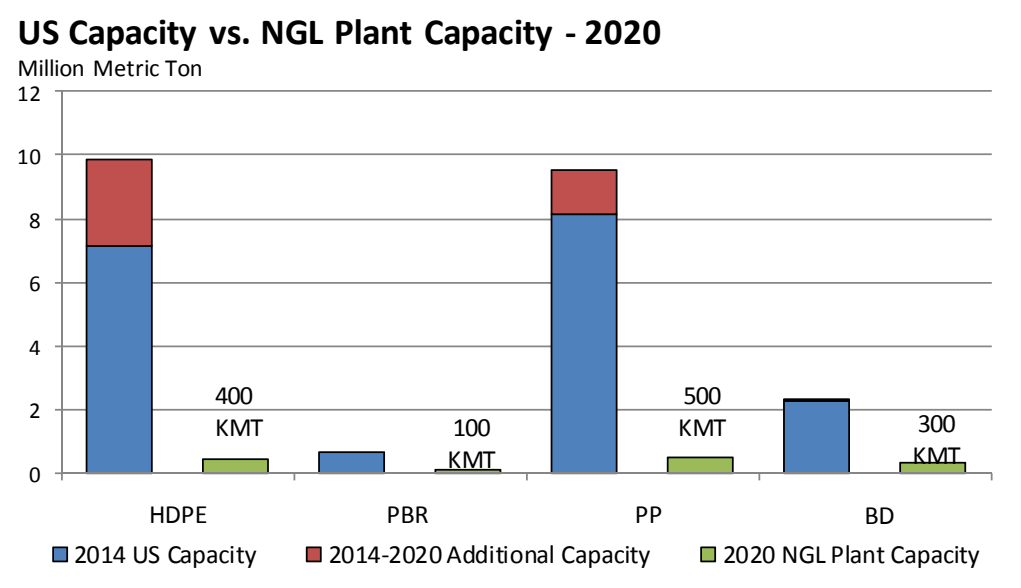
- North Dakota netbacks based on Conway less transportation & separation costs.
- Prices are expected to gradually rise over the next 25 years.

Source: IHS CERA, Statistics Canada, OPIS

Product and Feedstock Prices Setting Mechanisms for North Dakota

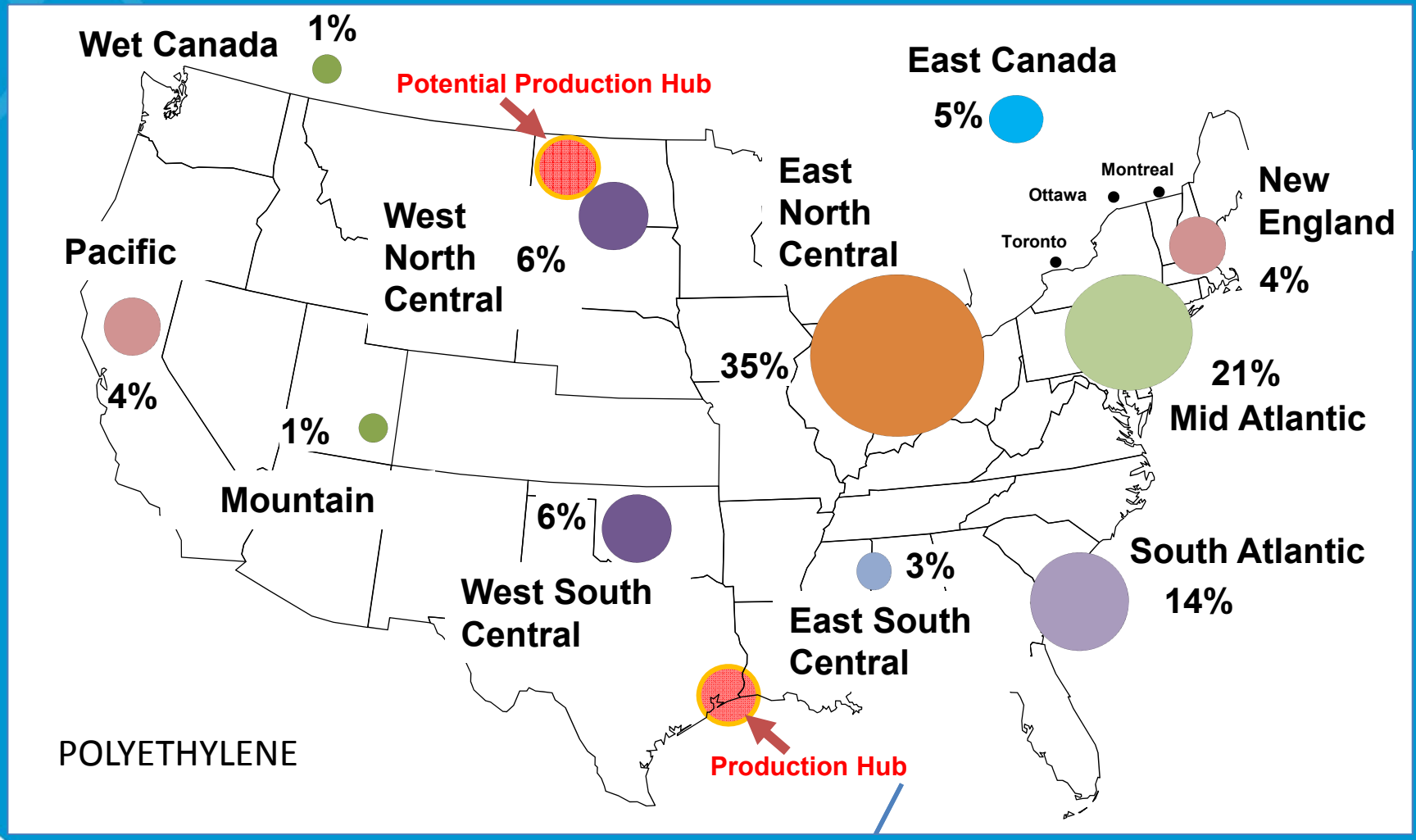


Proposed Plants Would be a Small Percentage of US Capacity



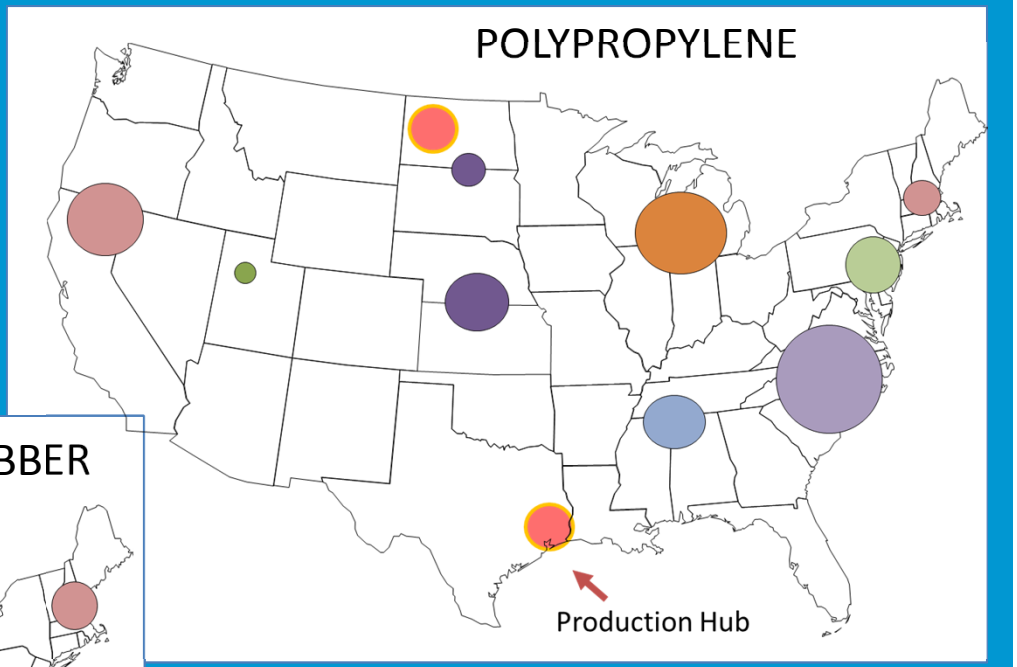
- The HDPE and PP plants represents a small percent of total capacity in the US in 2020 and of the required capacity addition required to satisfy US supply/demand dynamics
- PBR and butadiene plants represent a larger portion of the existing capacity, especially with no forecast new capacity, but are expected to capture market share based on competitive cost

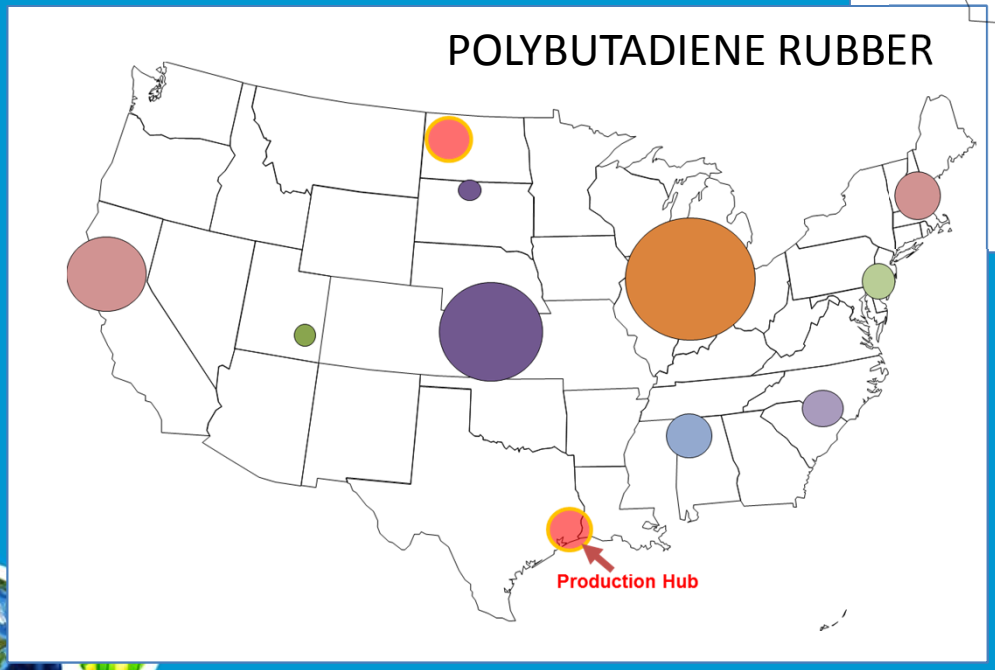
More than half of the PE consumption in US is within reach of a North Dakota Plant



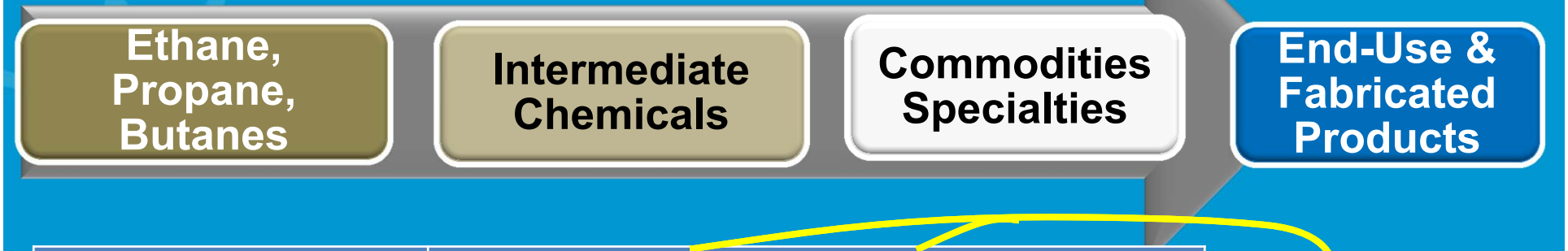
Most of the production is centered in the Gulf Cost

The Proximity Situation is the Same for Other Commodity Polymers





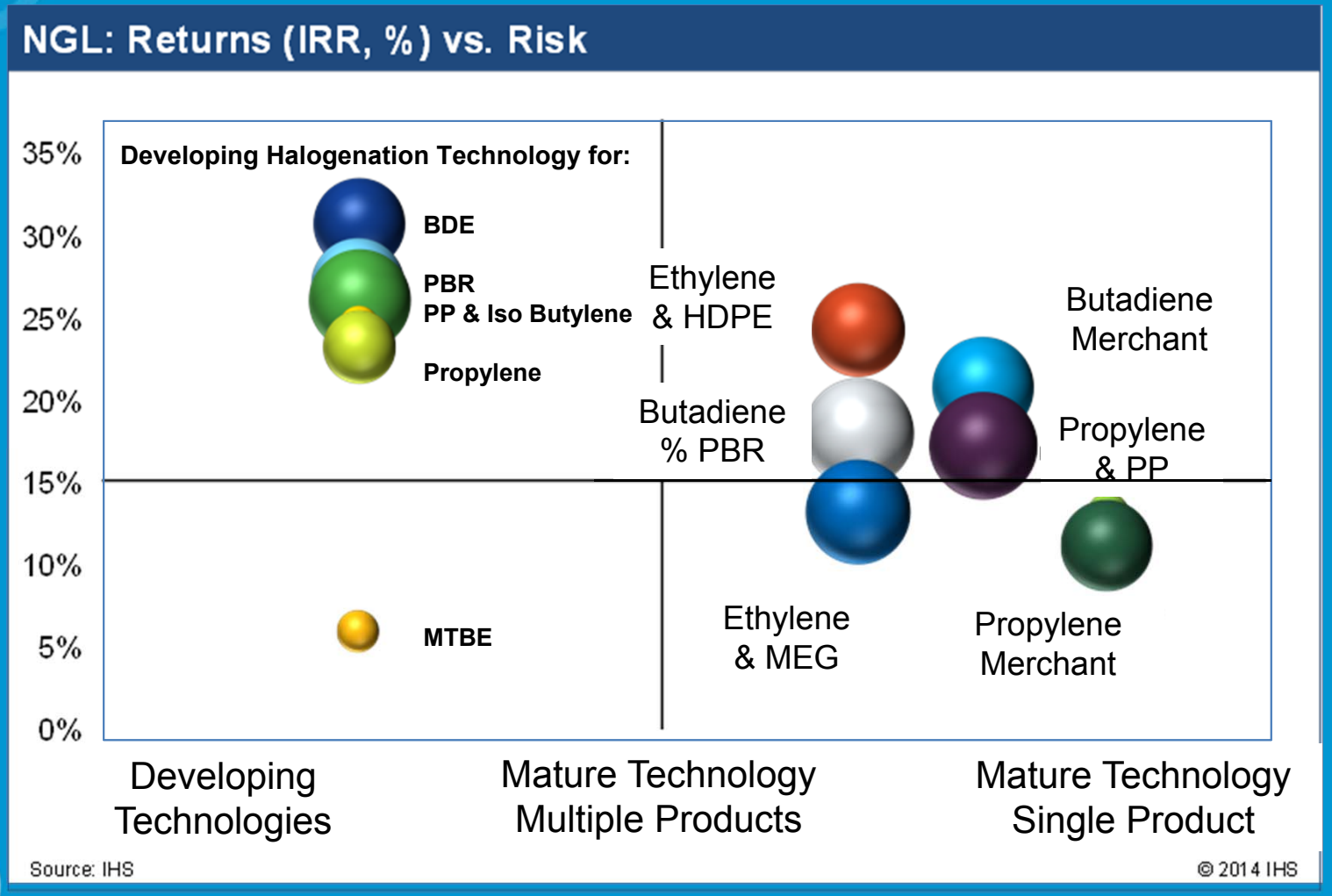
The Value of Basic Feedstock Typically Increases Down the Supply Chain



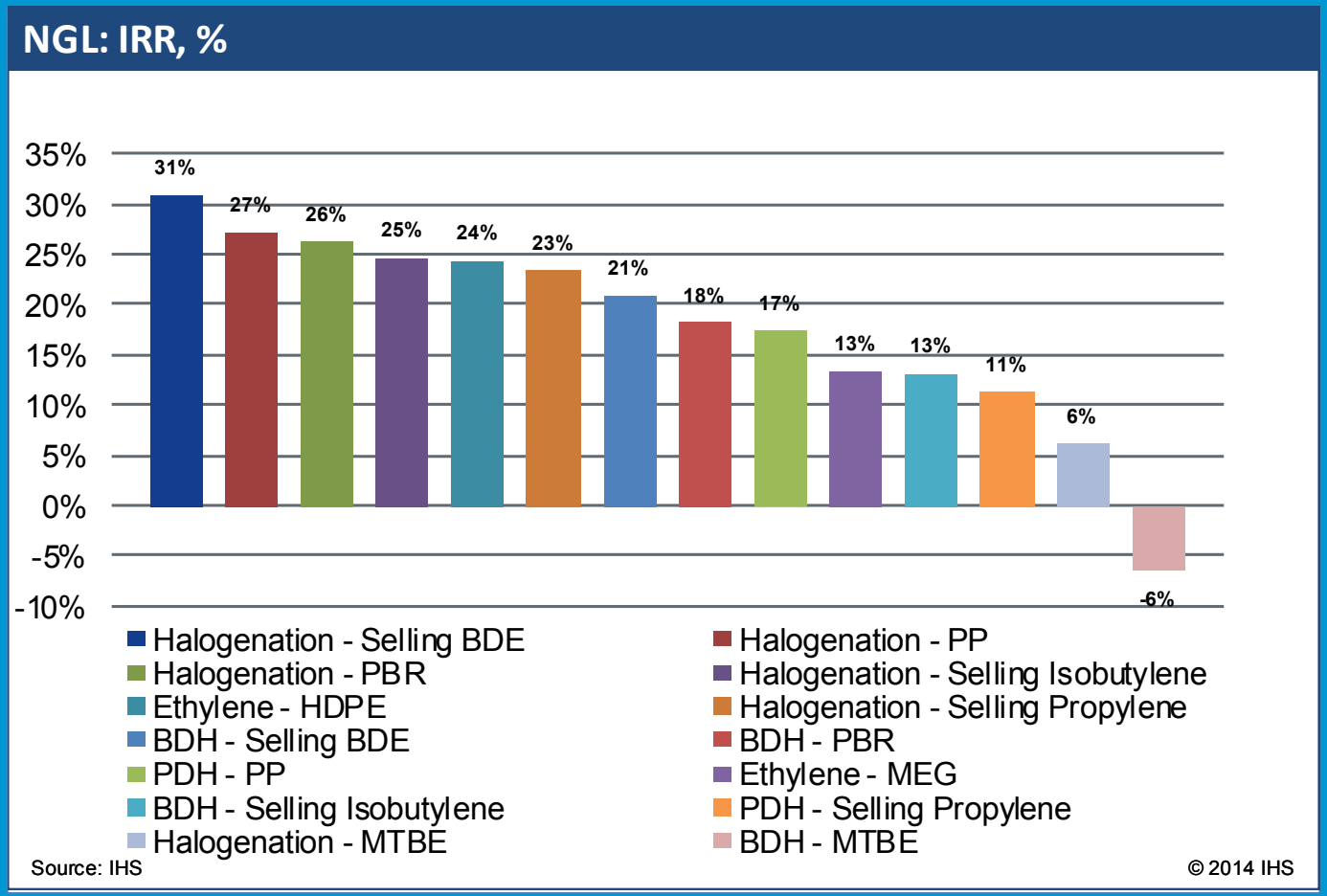
	Ethane	Ethylene	HDPE
Volume (T)	1	1.29	1.30
Value ($/T)	197 (27c/gal)	938	1507
-------- Combined	Ethane	Equivalent	----------
Value in product ($/T)	197	727	1157
Capacity (KT/YR)	27,500 bpd	404	400 (880 mm lb/yr)
Investment (MM USD)		940	310
Return IRR (%)		21%	24%

Capital and operating cost at each step generate the value increase

Advantages for the North Dakota Translate in Value-Add Opportunities



Financial Model Results – for NGL Derivatives



Conclusions

- ✓ Feasible opportunities for the development of NGL-based chemical derivative look promising
- ✓ There should not be any particular environmental or permitting issues for the process technologies selected if Good Engineering Design and HAZOP principles are followed. Note that the Halogenation technology will need to be designed with specific attention to bromine handling and processing.
- ✓ Growth in the United States demand and competitive cost exports will drive significant production capacity (supply) additions of commodity chemicals and polymers

Conclusions (continued)

- ✓ Ethane in the U.S. will remain in an oversupply situation due to the associated supply from shale-based oil and gas that will drive North Dakota post-2020 net back prices to historic low values
- ✓ North Dakota is expected to have an ample supply of NGLs (ethane, propane and butane)
- ✓ North Dakota will have a long-term "Advantaged feedstock" position of NGLs the U.S. Gulf Coast and Asia/Europe

Conclusions (continued)

- ∞ Project and business development "success" can yield a variety of sustainable benefits to North Dakota State (residents) and 3rd party sponsors and developers
- ✓ To be successful, North Dakota must aggressively solicit world-class private (chemical) industry participants/sponsors on a global basis who can bring proven project development expertise, financial strength, chemical process technology and access to customer marketing channels and customers

Conclusions (continued)

- Participants can be along the value chain e.g., from NGL processors considering value-add downstream investment to end-user part fabricators interested back integration to low cost secure feedstock supply
- Monitoring competitor actions in the U.S. and Western Canada is necessary as the rapid pace of shale-based project (global) interest and development continues

Cautions

- Investment (cost and labor resources) are very significant to construct downstream chemical production plants (and build their associated businesses)
- Project development and implementation (including market entry) will have challenges
- This Project will be forging new ground in North Dakota, thus project development and implementation must be done according to a well-defined and very robust roadmap, with an iterative loop for lessons learned along the way.

Value Add via Ethanol Derivatives and other Biochemicals

There are Several Industry Drivers for Bio-Chemicals

- Sustainability pressures throughout the supply chain from end to end
- Ultimate consumers and retail need to serve a more green-aware purchasing generation
- Site-related factors for CO2 reduction
- Provide Supply Gap options
- Potential for Cost Reduction
- New Materials Available

Major Consumers of Chemicals are Looking to Enhance Sustainability

Company	Sustainability Goal
Coca-Cola	Full conversion to PlantBottle™ Packaging by 2020 to diversify away from fossil fuels and reduce the Coca Cola System carbon footprint.
Heinz	Use packaging materials derived from **renewable** sources to reduce carbon footprint
Nestlé	Develop and use packaging materials made from sustainably managed **renewable** resources such as bioplastics
PEPSICO	Reduce packaging footprint through the use of **renewable** sources (such as a 100% plant-based PET bottle)
P&G	Use 100% **renewable** or recyclable materials in all products and packaging
Target	Expand selection of sustainable product choices such as household cleaning products made from **natural ingredients**

Basis and Assumptions for Alternative (to Corn) Biomass Analysis

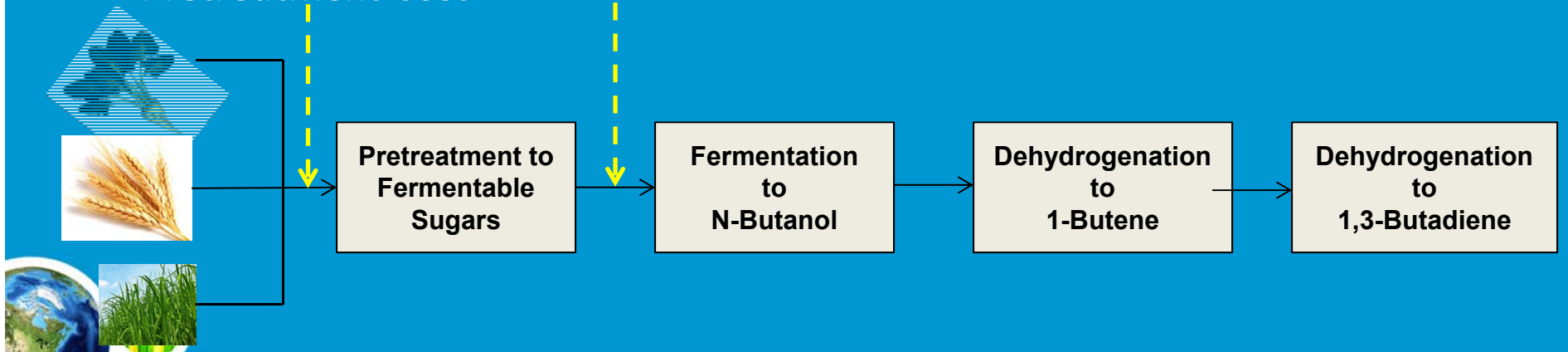
- The fermentable sugars in biomass are the cellulose (glucans, C6 sugars) and hemicellulose (xylans, C5 sugars) portions, extracted from the biomass through a high pressure high temperature hydrolysis pretreatment.
- 9 cents per pound (dry) is the price that IHS believes the fermentable sugar-containing stream must be going into the fermenter (after a pretreatment step) to achieve feasible economics for the production of derivative chemicals (e.g. netback fermentable sugar price).

Basis and Assumptions for Alternative (to Corn) Biomass Analysis (continued)

- **Biomass netback pricing is based on a price for fermentable sugars of 9 cents per pound, after a pretreatment step, which further reduces the viable price of the raw biomass source as shown in a proxy bio butadiene production facility.**

Sugar portion in biomass: 4.5 c/lb – Pretreatment Cost

Fermentable sugar extracted from biomass: 9 c/lb



Basis and Assumptions for Alternative (to Corn) Biomass Analysis (continued)

- Biomass crop market pricing and harvest yields are based on a 5 year average of the most recent market metrics in North Dakota, according to the USDA.
- Sugar beets have a high starch content, which can be extracted with a pretreatment step that is less intensive and less costly than the hydrolysis for other biomass sources
- For wheat and switchgrass, we assumed a more costly pretreatment process of about 4.5 cents per dry pound of fermentable sugar, driving the viable price of fermentable sugars down to 4.5 c/lb.

Feedstock Requirements and Estimated Required Netback Price (100 KMT BD Plant)

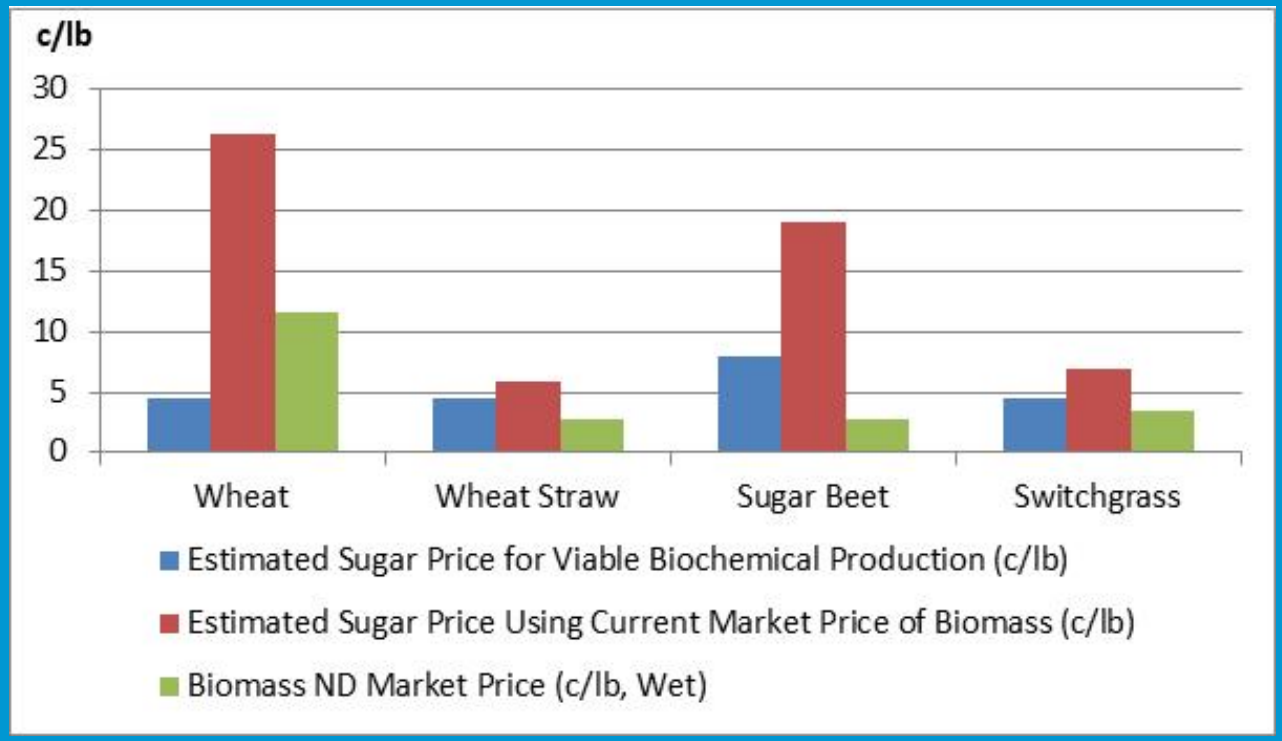
	Wheat	Wheat Straw	Sugar Beet	Switchgrass
Biomass Netback Price ($/MT Dry)	50.99	52.63	103.62	57.09
Biomass Netback Price ($/MT Wet)	43.34	47.37	25.90	50.24
Biomass Netback Price (c/lb Wet)	2.0	2.1	1.2	2.3
ND Market Price ($/MT Wet)	253.53	61.46	61.72	76.81
Biomass ND Market Price (c/lb Wet)	11.5	2.8	2.8	3.5
Estimated Sugar Price Using Current M	26.3	5.8	19.1	6.9
Estimated Sugar Price for Viable Bioch	4.5	4.5	8.0	4.5
Annual Biomass Req. (MTA wet)	**1,033,639**	**948,526**	**3,106,512**	**890,408**
Annual Biomass Req. (lbs. wet)	**2,278,781,791**	**2,091,140,425**	**6,848,678,328**	**1,963,011,335**
Biomass Req. (wet lb/gal butanol)	**44**	**41**	**133**	**38**
Yield (lb/acre)	2,754	3,580	44,991	6,535
Total Land Required (acres)	**827,444**	**584,085**	**152,224**	**300,407**
Starch (dry)	0%	0%	15%	0%
Hemicellulose (dry)	25%	24%	21%	29%
Cellulose (dry)	34%	37%	31%	37%
Lignin (dry)	15%	9%	0%	19%
Moisture	15%	10%	75%	12%
MT Biomass (wet) / MT BD	**10.34**	**9.49**	**31.07**	**8.90**
MT Sugar (C5+6) / MT BD	**4.52**	**4.53**	**4.56**	**4.51**
MT Acetone / MT BD	**0.25**	**0.25**	**0.25**	**0.25**
MT n-Butanol / MT BD	**1.58**	**1.58**	**1.58**	**1.58**
MT 1-Butene / MT BD	**1.15**	**1.15**	**1.15**	**1.15**
MT BD	**1.00**	**1.00**	**1.00**	**1.00**

NOT ECONOMICAL for the FARMER

NOT ECONOMICAL for the BIO PLANT

Netback Pricing vs. Market Prices

- **Alternative biomass types are expected not to be viable alternatives to corn and corn-based biomass as biochemical feedstock.**



Potential for Ethanol as a Petrochemical Feedstock

- Ethanol production has the potential for higher value as a petrochemical intermediate vs. fuel value
- Additionally, existing ethanol plants can be retrofit to butanol production at a lower than grass-roots capital cost, opening the door for other derivative possibilities
- Bio-chemical production can be used to fill supply gaps in conventional petrochemical production
- Also, there may be logistical advantages (supply chain) to markets now being served by the US Gulf Coast petrochemical hub

There is a Wide Range of Industrial Bio-Chemical Development

Here is a small sample…..

C_1s	Methanol	PMMA/POM
C_2s	Ethanol, Glycolic Acid	PGA, PE, EPDM, PS, PET
C_3s	Propanol, Lactic Acid	PP, EPDM, PLA
C_4s	Succinic Acid, Butanol, BDO	Butadiene, PBT, TPU, PMMA, PBS
C_5s	Isoprene	SIS/SEPS, Elastomers
C_6s	Glucaric/Adipic Acid, Isosorbide	PA 66, Green-PC
Aromatics	PX, benzene	PS, PET
C_8+	Functional Chemicals	Specialty Chemicals

PMMA: polymethylmethacrylate
POM: polyoxymethylene or polyacetal resin
PGA: polyglycolic acid
PE: polyethylene
EPDM: ethylene propylene diene monomer
PS: polystyrene

PET: polyester or PET resin
PP: polypropylene
PLA: polylactic acid
BDO: butanediol
PBT: polybutylene terephthalate
TPU: thermoplastic polyurethane

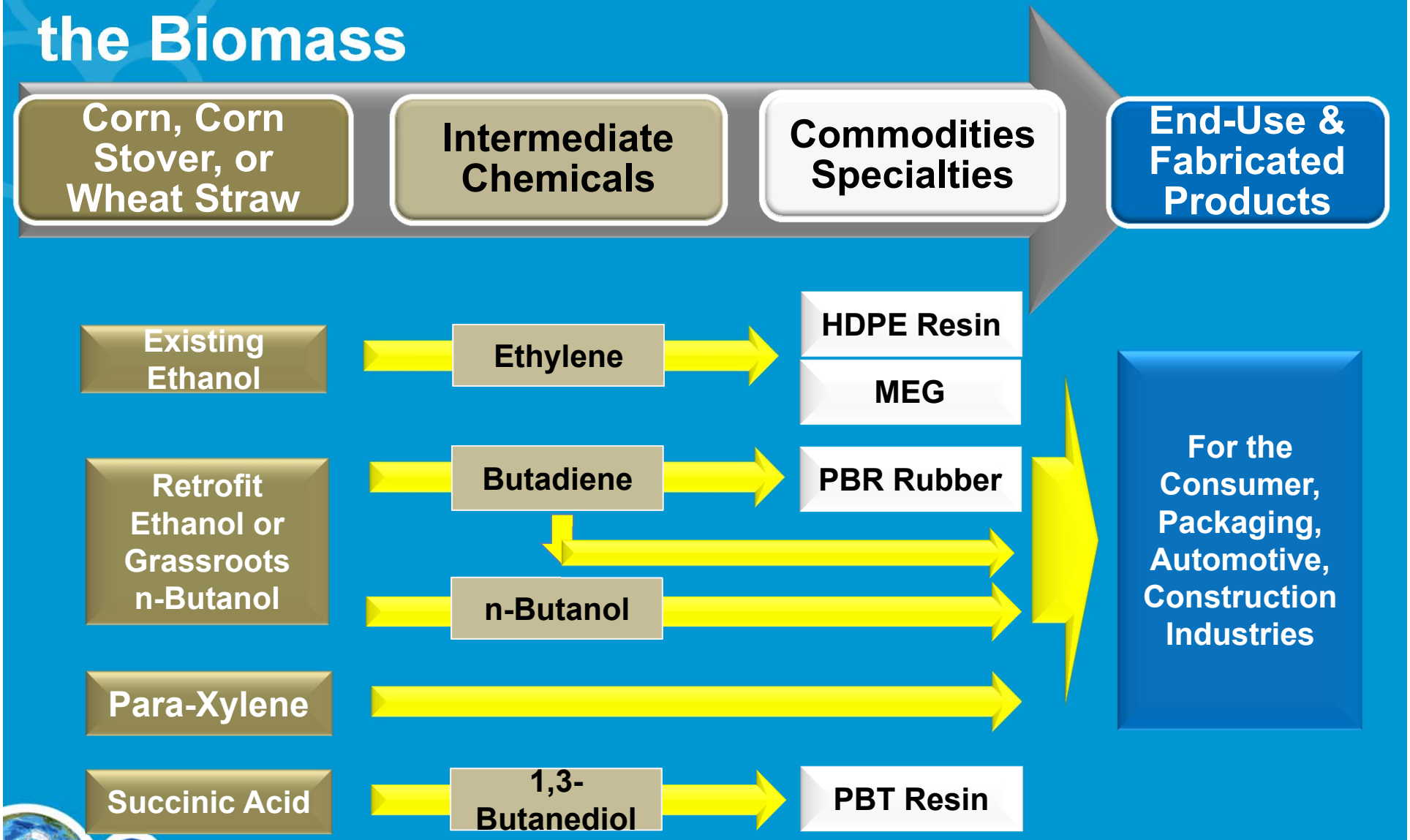
PBS: polybutylene succinate
SIS/SEPS: styrene block copolymers
PA 6-6: nylon
Green PC: renewable sourced polycarbonate
PX: para-xylene

Bio-based Commodity Plastics Have a Limited Application at Premium Prices

- Bio-based monomers can be "drop-ins
- As any new or replacement material, bio-plastics will require a qualification procedure to ensure its equivalent performance

- IHS believes that at price parity, bio-plastics will have essentially unlimited opportunity
- However, a price premium will have to be absorbed by the resin producer, fabricator or final product owner; the consumer will not pay a higher price.
- At this time, IHS does not believe it is conservative to consider the production of bio-plastics based on a "green" price premium

The Likely Value-Add Opportunities for the Biomass

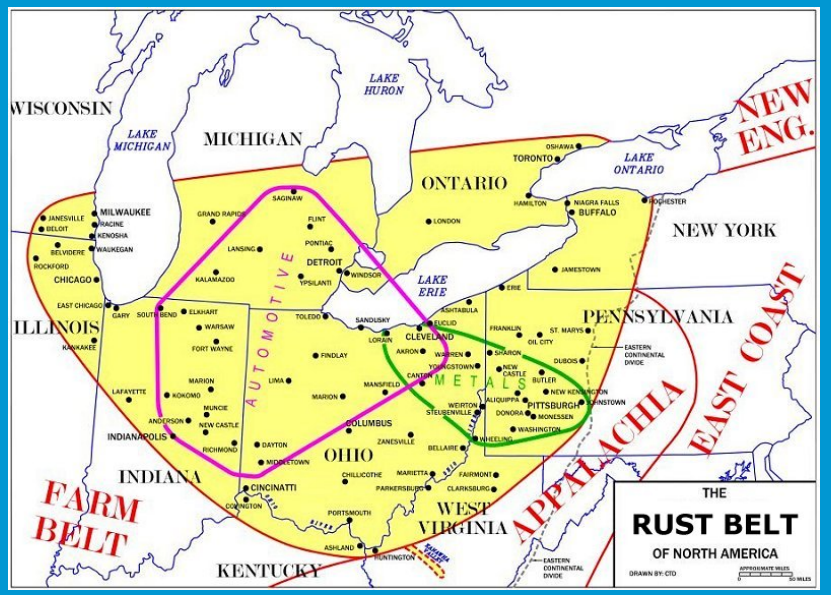


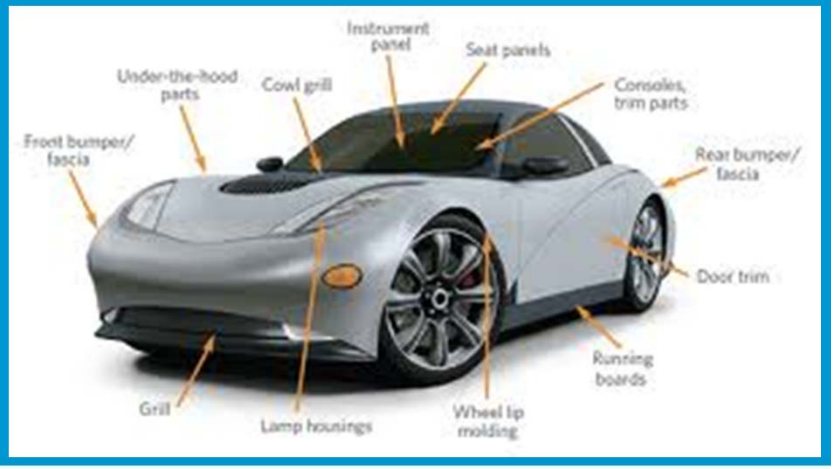
NGLs to Chemicals: Capacity and Capital Costs – North Dakota - 2020 Basis

	Bio		
Unit	**Capacity, kMT**	**Capital, USMM$**	**MM gal/yr**
Ethanol	180.00	128.00	60
Ethylene (Ethanol)	109.00	70.00	
HDPE	108.00	132.00	
EO	144.00	399.00	
MEG	189.00	122.00	
Butanol (Grass Roots Corn)	105.00	240.00	34
Butanol (Converted Corn)	105.00	206.00	34
Catalytic Dehydrogenation to Butene-1	77.00	42.00	
Butadiene (Butene-1)	69.00	71.00	
Polybutadiene	67.00	216.00	
Paraxylene (Corn)	50.00	513.00	
Succinic Acid (Corn)	38.00	337.00	
BDO	25.00	132.00	
PBT	50.00	73.00	

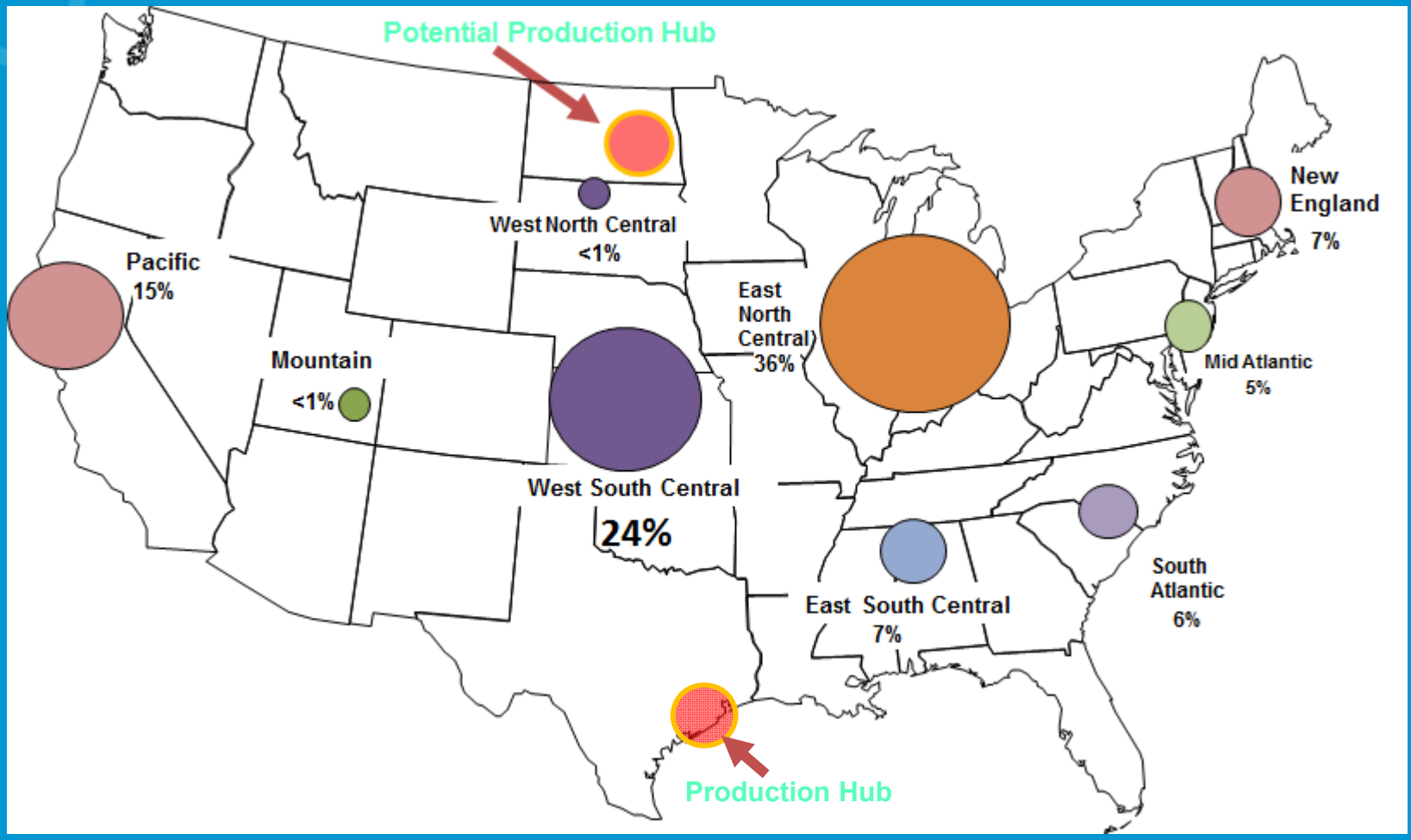
The Rust Belt is a Likely Destination for Products Produced in North Dakota

- **This geographical sector also includes the center of the US automotive industry, as indicated in the map:**
  - ***Michigan, Ohio and Indiana***
- **The automotive industry uses products targeted in our study:**
  - ***HDPE in Gas Tanks, Battery Boxes, Air Ducts, Splash Shields and Air Duct/channels which are part of the lower part of the dashboard.***
  - ***PB Rubber in tires and hoses***



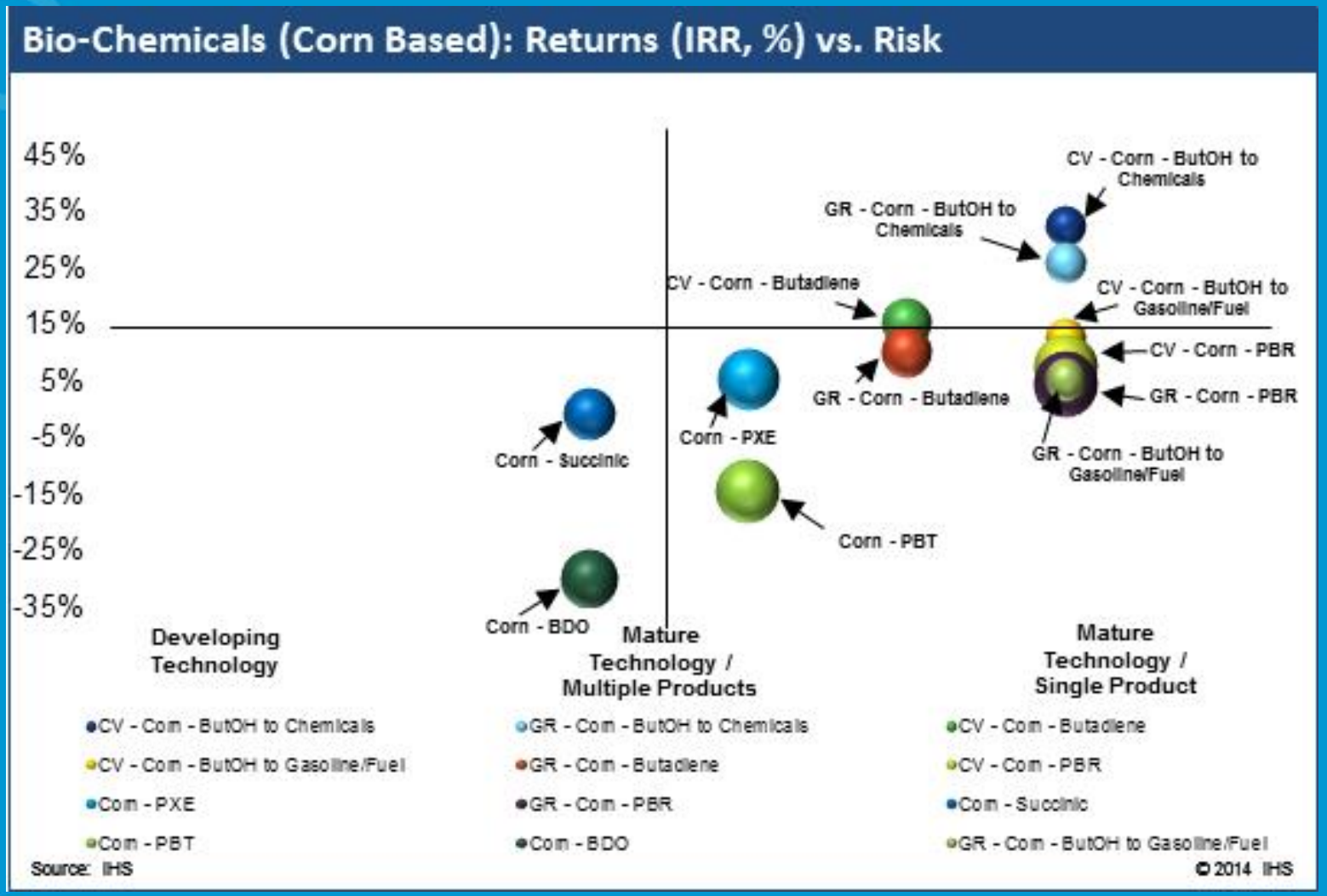


There is a Significant Market in Reach of a North Dakota Project *(ex., Butadiene Rubber)*



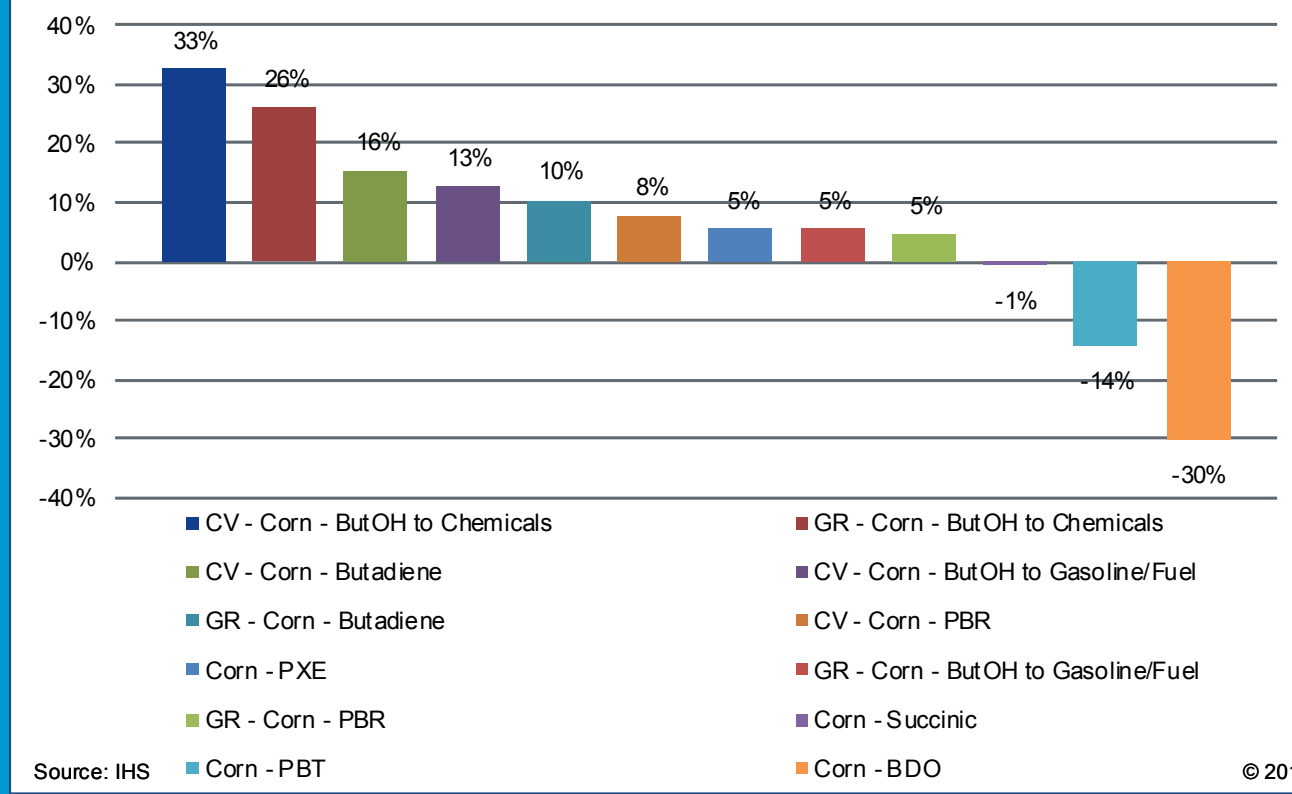
More than half of the consumption in US is within reach of a North Dakota Plant, while most production is centered in the U.S. Gulf Coast

Financial Model Results (Corn Based)



Financial Model Results (Corn Based)

Bio-Chemicals: Returns (IRR, %) vs. Risk



Source: IHS

Conclusions

- ✓ Feasible opportunities for the development of bio-based (corn, corn stover, wheat straw) chemical derivative look promising
- ✓ There should not be any particular environmental or permitting issues for the process technologies selected if Good Engineering Design and HAZOP principles are followed
- ✓ Growth in the United States demand will drive significant production capacity (supply) additions of commodity chemicals and polymers

Conclusions (continued)

- ✓ North Dakota has an "Advantaged geographic" location relative the U.S. Gulf Coast for supplying commodity polymers and end-users e.g., for the fabrication of automotive and consumer-related parts and components
- ✓ Commodity chemical intermediates (butadiene, n-butanol) can be easily transported (railed) to the U.S. Gulf Coast
- ✓ Economics from corn, corn stover or wheat straw are relatively similar based on IHS price forecasts, permitting biomass flexibility going forward

Conclusions (continued)

- Project development and implementation will have challenges that must be defined and managed carefully
- Investment (cost and resources) to construct the world-scale downstream chemical production plants and build their associated business, are very significant
- By nature of bio-chemical production and feedstock collection issues, bio-chemical plant capacities are generally small in comparison to conventional petrochemical world scale plants and suffer from lack of economy of scale and cost competitiveness, limiting the options available and minimizing any product delivery logistics advantages

Conclusions (continued)

- North Dakota has essentially no commodity chemical business and technical infrastructure (except ammonia and fertilizers); thus market entry into "new" commodity chemicals and polymers will have challenges on many levels, including availability of skilled and professional labor
- Project and business development "success" can yield a variety of sustainable benefits to North Dakota State (residents) and 3rd party sponsors and developers

Conclusions (continued)

- ✓ **To be successful, North Dakota must aggressively solicit world-class private (chemical) industry participants/sponsors on a global basis who can bring proven project development expertise, financial strength, chemical process technology and access to customer marketing channels and customers**
- ✓ **Participants can be along the value chain e.g., from the basic bio-commodity chemical producer considering value-add downstream investment to end-user part fabricators interested back integration to low cost secure feedstock supply**

Conclusions (continued)

- **This Project will be forging new ground in North Dakota, thus project development and implementation must be done according to a well-defined and very robust roadmap, with an iterative loop for lessons learned along the way.**

State Incentive Programs

Economic Incentives are Dependent on Project Scope and Can Take Many Forms

- **Typical Economic Development Incentives by Type:**
  - Financial tax incentives: credits, deductions, abatements, payment in lieu of taxes (known as PILOTs)
  - Financial capital incentives: grants, low-interest loans, interest rate subsidies
  - **In-kind services: site improvements, job training, permit assistance**
  - Special districts: empowerment and enterprise zones
  - Miscellaneous incentives
- **Other Support**
  - **Ease of permitting**
  - **Infrastructure Development**

Examples of State Incentive Programs

Financial Tax Incentives in Ohio

- **Ohio Job Creation Tax Credit**
  - At least 10 full time equivalents and $660,000 in annual payroll over three years
    - Sector 325110 average annual wage in OH is $90,100 (all occupations)
- **Credit limited to 75% state personal income tax withholdings**
  - Can be taken against four OH taxes, including business franchise and corporate net income tax
  - Up to 15 years
  - Refundable
  - Sample calculation assuming 300 jobs - annual credit would be $801,800

Financial Tax Incentives in Ohio (continued)

- **Other Ohio Economic Development Incentives**
  - Business incentive and economic development grants
  - Ohio Bond Fund and low interest loans (Section 166, refers to applicable regulation)
  - Workforce grants and in-kind services
  - R&D tax credit
  - Special districts, such as enterprise and empowerment zones, reinvestment areas, and brownfields.

Financial Tax Incentives in Pennsylvania

- **Job Creation Tax Credits**
  - Based on number of jobs created in three years
    - At least 25 new jobs or 20% increase
  - Credit per job is $1,000 and $2,500 if unemployed worker used
    - Sector 325110 average annual wage in PA is $80,300 (all occupations)
  - Credit can be taken against seven PA business taxes
  - Example assuming 300 operating jobs - annual tax credit of $345,000

Financial Tax Incentives in Pennsylvania (continued)

- **Pennsylvania Resource Manufacturing Tax Credit**
  - Machinery and Equipment Loan Fund (MELF)
    - Availability of funds uncertain
  - Low Cost Capital through programs such as "PA First", Pennsylvania Economic Development Authority taxable bond program, PA Industrial Development Authority
  - Infrastructure development (highly site specific)
  - Job Training
  - Special districts: Keystone Opportunity Zone/Keystone Opportunity Expansion Zone, Keystone Special Development Zones, Industrial Sites Reuse, Tax Increment Financing

Financial Tax Incentives in West Virginia

- **Economic Opportunity Tax Credits (EOTC)**
  - Five types of EOTC credits – general, corporate HQ, small business, high tech, and job creation
  - Only one EOTC credit per investment, but can apportion
  - EOTC tax credits can be used with other WV incentives
- **General EOTC Tax Credit**
  - Qualifying invest. based on dollar value of initial investment, equipment life, and number of jobs
    - Qualifying investment can be up to 35% of initial investment for 520 or more jobs
    - Credit pro-rated over 10-year period
  - Credit taken against corporate net income tax
  - Credit is limited to state tax obligation

Financial Tax Incentives in West Virginia (continued)

- **General EOTC Tax Credit (continued)**
  - **Not refundable or transferable, but three year carry forward after 10 years**
  - **If initial investment was $1.5 billion and 300 operating jobs, potential credit likely offsets virtually all of WV corporate income tax obligation**
- **EOTC Job Creation Tax Credit**
  - **At least twenty new full time jobs at $32,000 with health benefits**
  - **Tax credit of $3,000 per job for five year period**
  - **Credit against four state taxes, including corporate net income**
  - **Not refundable or transferable**
  - **If 300 new jobs – annual credit is $900,000**

Financial Tax Incentives in West Virginia (continued)

- **Five for Ten Program**
  - Incentive: Abatement of 95% of real property taxes pro-rated for 10 years
  - Eligibility: facilities in NAICs 211112- Natural Gas Liquids Extraction, or that use products from such a facility and invest at least $2 billion
  - Sample calculation assuming:
    - Real property of $200 million
    - Assessment ratio of 60% (statewide figure for manufacturing real property)
    - Real property tax rate $2.50/$100 of assessed value
  - Annual reduction in real property taxes is $285,000

Financial Tax Incentives in West Virginia (continued)

- **Manufacturing Investment Tax Credit**
  - Incentive: avoid up to 60% of liability for the 3 state taxes, including the corporate net income tax
  - Credit is 5% of qualified investment, pro-rated over 10 years
    - Includes real property, tangible personal property (equipment), refurbishment
  - Not refundable or transferable, no carryover
  - With $1.5 billion in investment, 60% obligation would likely be offset

Financial Tax Incentives in West Virginia (continued)

- **Manufacturing Property Tax Adjustment Credit**
  - Credit against local personal property taxes paid on manufacturing inventory
  - Value of credit depends on local tax rate, value of inventory
  - Cannot be estimated at this time, likely small
  - Not refundable or transferable, no carryover
- **Other Economic Development Incentives in WV**
  - Special property tax valuation for air and water pollution control equipment
  - On the Job training services
  - Guaranteed Workforce Program
  - WV Economic Development Authority (WVEDA) loan program
  - Special districts: empowerment zones, Appalachian Regional Commission, TIFs

Types of Potentially Interested Sponsor Companies

There Should Be Several Companies Interested in Ethylene/HDPE

- **US ethylene producers who are currently integrated into HDPE**
  - Equistar
  - ExxonMobil
  - Dow
  - Chevron Phillips
  - Ineos
  - FPC USA
  - BASF/Total LLC
- **US ethylene producers**
  - Williams
- **International producers not yet with a US presence**
  - Vinmar (US)
  - Braskem (Brazil)
  - SABIC (Saudi Arabia)
  - Reliance (India)
  - Sinopec (China)
  - PTTGC (Thailand)

There is a Large Automotive Market Advantageously Located for a ND HDPE Plant

Fabricator	Locations	KMT HDPE Used, 2013
ABC Group	ON, Canada	
Plastic Omnium SA	WI	
Chicago Growth Partners	IL	
Nordic Group	WI	
Penda Corporation	WI	
PolyOne Corp.	WI	
Honda America Corp.	OH	
Custom-Pak, Inc.	IA	
		215

IHS Believes There Would Be Several Companies Interested in Propylene/PP

- **US propylene producers who are currently integrated into PP**
  - ExxonMobil
  - Chevron Phillips
  - BASF/Total LLC
  - FPC USA
  - Ineos
  - Flint Hills Resources
  - Braskem
- **US propylene producers**
  - Enterprise Products
- **International producers not yet with a US presence**
  - Vinmar (US)
  - Mitsui Chemical (Japan)
  - Hyosung (Korea)
  - Reliance (India)

There is a Large Automotive Market Advantageously Located for a ND PP Plant

	KMT PP Used, 2013
ABC Group	ON, Canada
Windsor Molding	ON, Canada
Flex-N-Gate Corp.	MI; ON, Canada
Honda America Corp.	OH
Continental Structural Plastics	MI
Kamco Industries, Inc.	OH
Bhar Inc.	IN
International Automotive Components Group	OH; IN
Key Plastics, L.L.C.	MI
Steere Enterprises, Inc.	OH
Tigerpoly Manufacturing, Inc.	OH
Toyota Gosei	MO

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There Should Be Several Companies Interested in Butadiene

- **US butadiene producers**
  - ExxonMobil
  - Equistar
  - Shell
  - TPC Group
- **US butadiene producers who are currently integrated into PBR or SBR**
  - BASF/Total
- **Foreign producers integrated into PBR and/or SBR not yet with a US presence**
  - Versalis S.p.A. (SBR) (Italy)
  - LG Chem (PBR and SBR) (Korea)
  - JSR (PBR and SBR) (Japan)
  - Petrochina (PBR and SBR) (China)

A Large Tire Market is Advantageously Located for a ND BD Plant (PBR and SBR)

US Tire Producers		KMT PBR and SBR Used, 2013
Bridgestone	QU; IL; IO; OH	
Continental	IL; OH	
Cooper	OH	
Goodyear	ON; QU; IL; NY; OH	
Michelin	NS; ON; IN; OH	
Sumitomo	NY	
Toyo	IL	
Trelleborg	OH	
Yokohama	IL	
		100 - 150

There Should Be Several Companies Interested in n-Butanol

- **US butanol producers who are currently integrated into butanol derivatives**

US Butanol producers	Acrylate esters	Butyl acetate	glycol ethers
BASF	√	√	√
Dow	√	√	√
Eastman		√	√
OXEA Corp		√	
Sasol	√		√

- **Foreign producers not yet with a US presence**
  - **FPC**
  - **LG Chem**
  - **Mitsubishi Chem**

This Study Next Steps

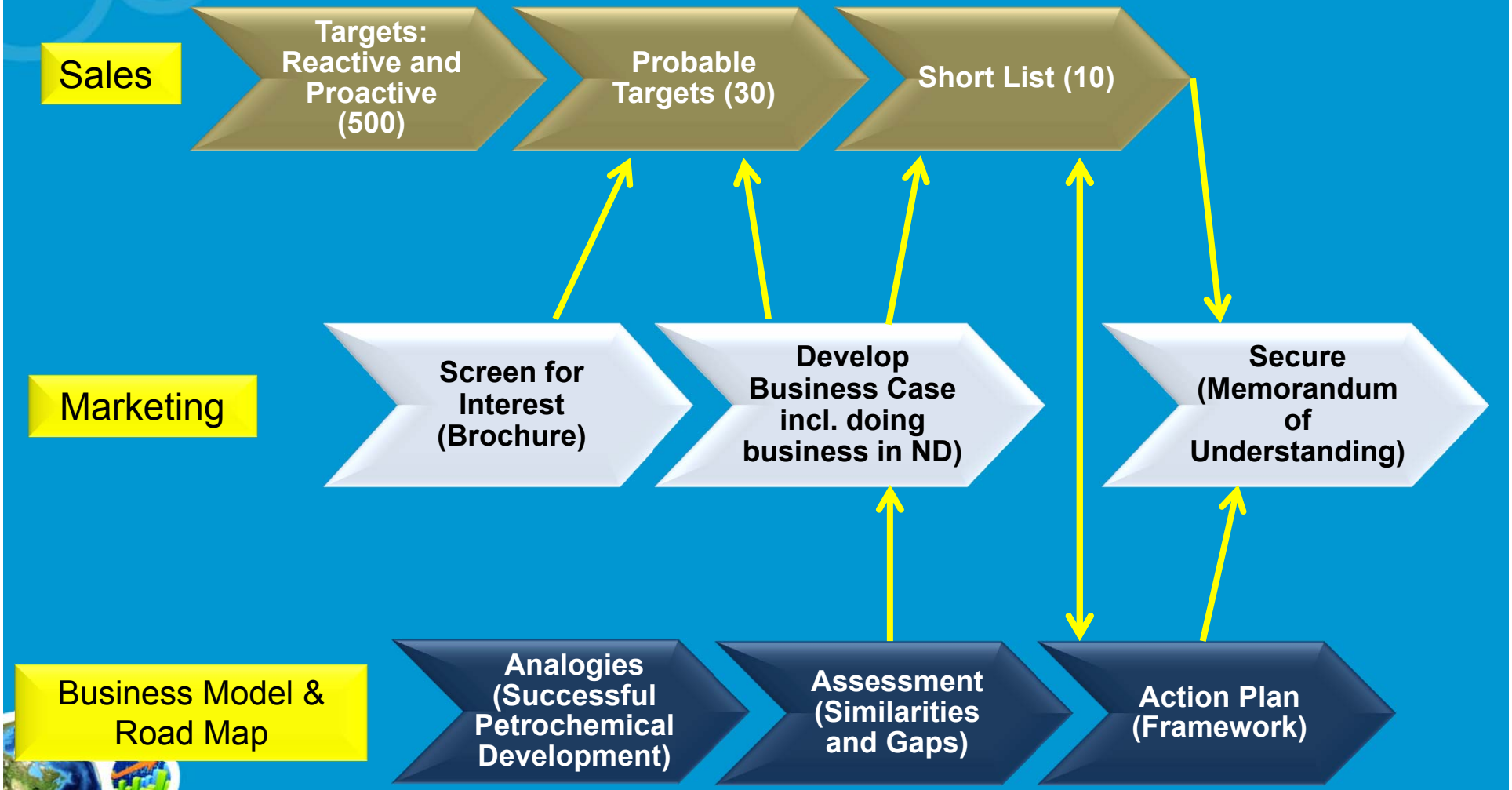
- **Deliverables**
  - **Report to Legislative Management – Energy Development and Transmission Committee - due July 2014; IHS will present its May 2014 Final Report in a face-to-face meeting or teleconference**
  - **Report to appropriate committees at the beginning of the 2015 Legislative Assembly – due January 2015**

Post Study Steps That Should be Initiated Prior to the Legislative Review/Presentation

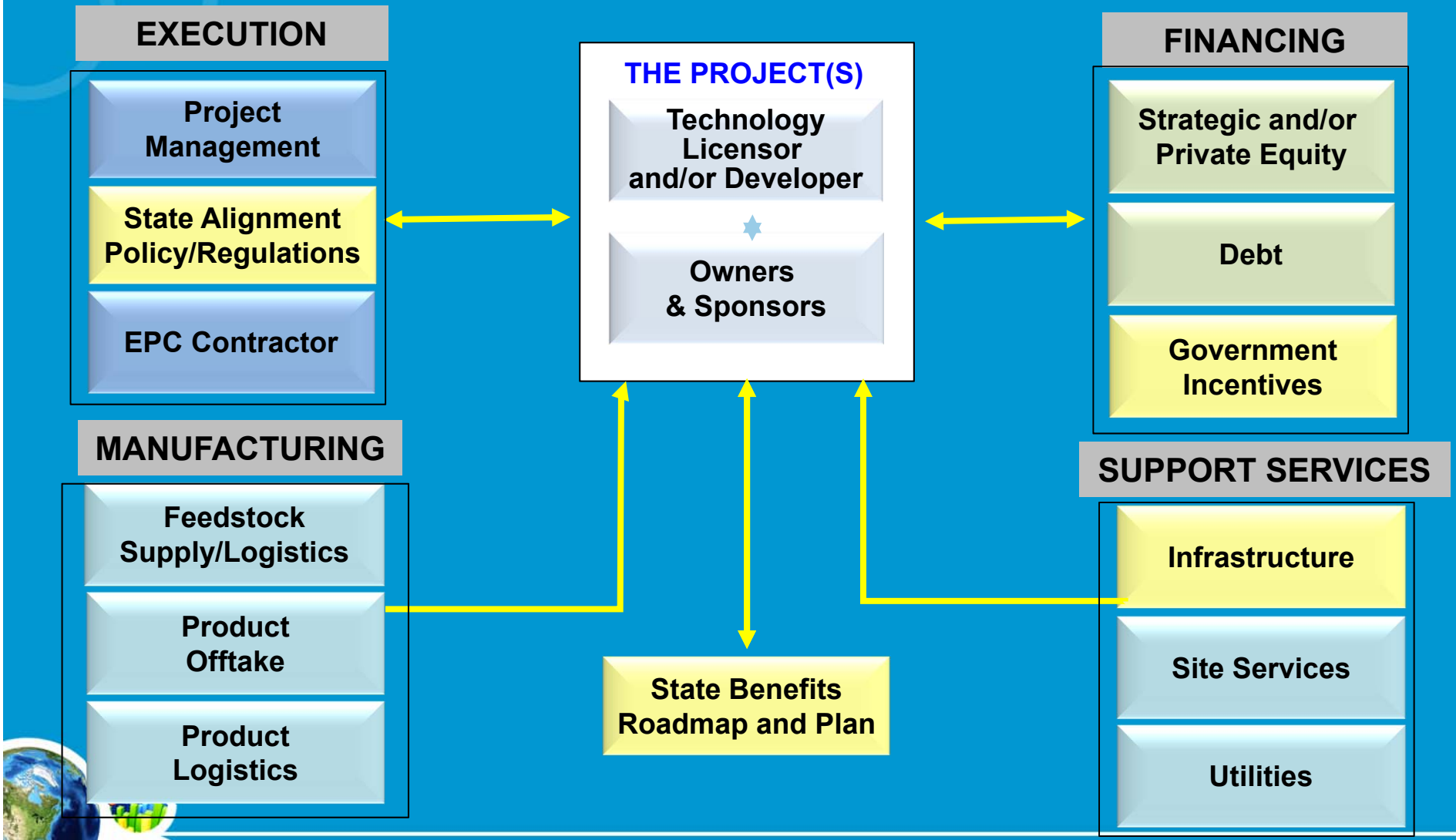
Post-Study Steps

- **Develop Business Plans and Solicit Investors (sales and marketing)**
- **Development of Master Plan**
  - **Effect of investment on the state**
    - **State project development benchmarking**
    - **Develop and 5, 10 and 15 year roadmap based on investor interest**
    - **Infrastructure and transportation logistics required and their funding**
    - **Resources (e.g., water and labor) required**
    - **Number of jobs (temporary and permanent) created**
    - **Businesses created to support the plant(s)**
    - **Potential for continued downstream (value chain) additions e.g., continued forward integration**
    - **Supporting, not directly related, social infrastructure business creation (e.g., housing construction, restaurants, entertainment, etc.)**
- **Added state revenue for each option (via current and future tax programs)**
- **Assessment of current/future State polices and legislation on the social, fiscal and environmental impacts of various development projects**

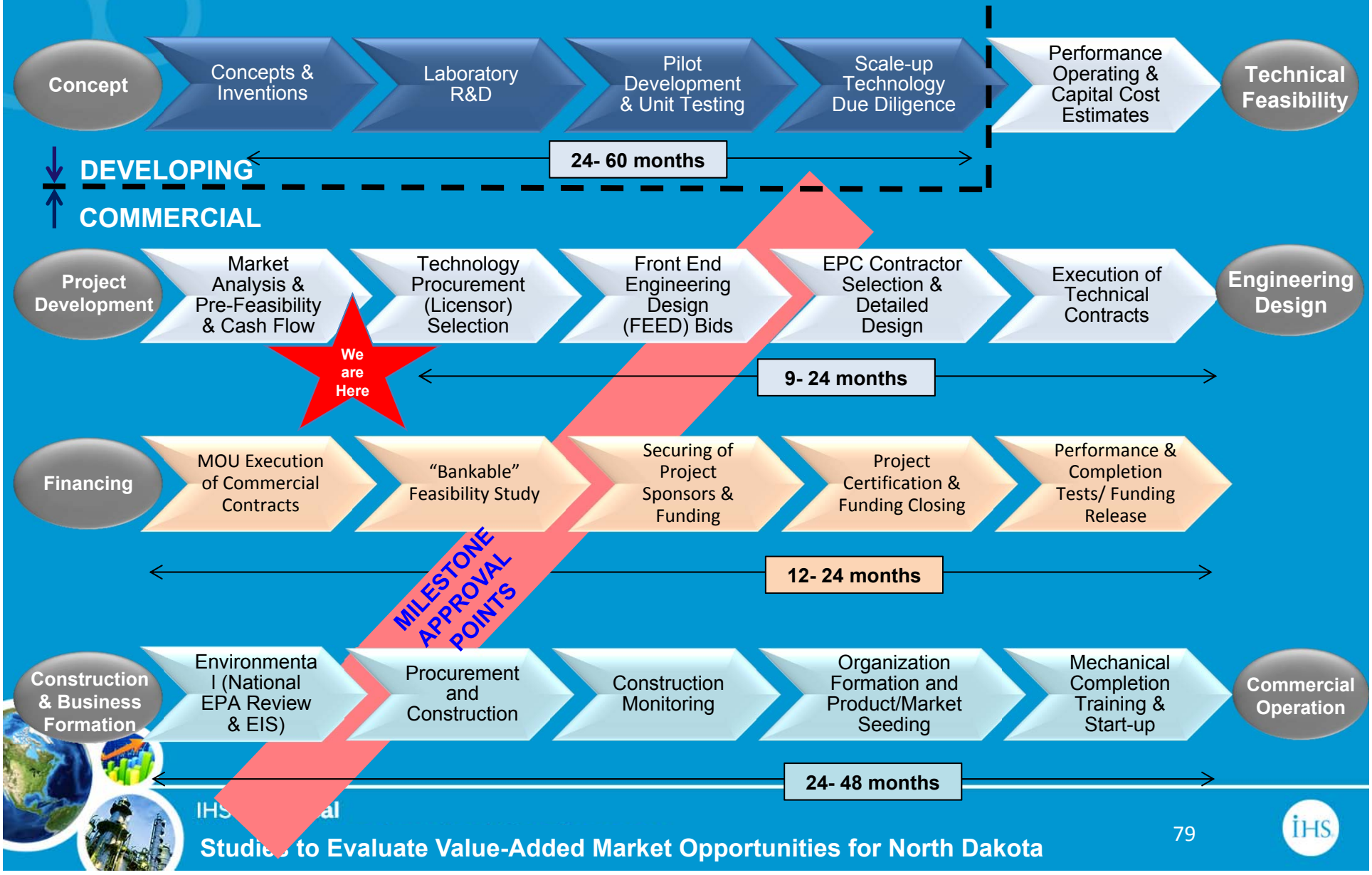
A Task Force(s) Need to Manage the NGLs and Ethanol Value-Add Initiatives



To Be Successful, Project Development Must "Execute" all the Fundamental Aspects



Project Development Tracks Need to be Executed in Parallel with Specific Activities



Studies to Evaluate Value-Added Market Opportunities for North Dakota

- ✓ Natural Gas Liquids (NGLs)
- ✓ Ethanol and Other Biochemical Derivatives

Don Bari, Vice President, Technology and Analytics Group
Edward Glatzer, Managing Director

June 5, 2014

Bismarck, North Dakota

Refined Coal

PRESENTATION TO EMPOWER COMMISSION

JUNE 5, 2014

Purpose/Request

- In 1989 Coal Beneficiation Tax language was passed to assess taxes on coal conversion performed at stand-alone facilities
  - E.g., creation of coal briquettes
- Those initially contemplated scenarios never commenced
- Refined coal produced within a broader coal conversion process (such as a coal-burning power plant) was never intended as target of the coal beneficiation tax
- Consequently, the same coal is taxed when:
  - It is mined (severance tax)
  - It is converted to electricity (coal conversion tax)
  - And when it is refined for reduced emissions (coal beneficiation tax)
- ***Proposal: exempt refined coal production for electric generation from beneficiation tax***

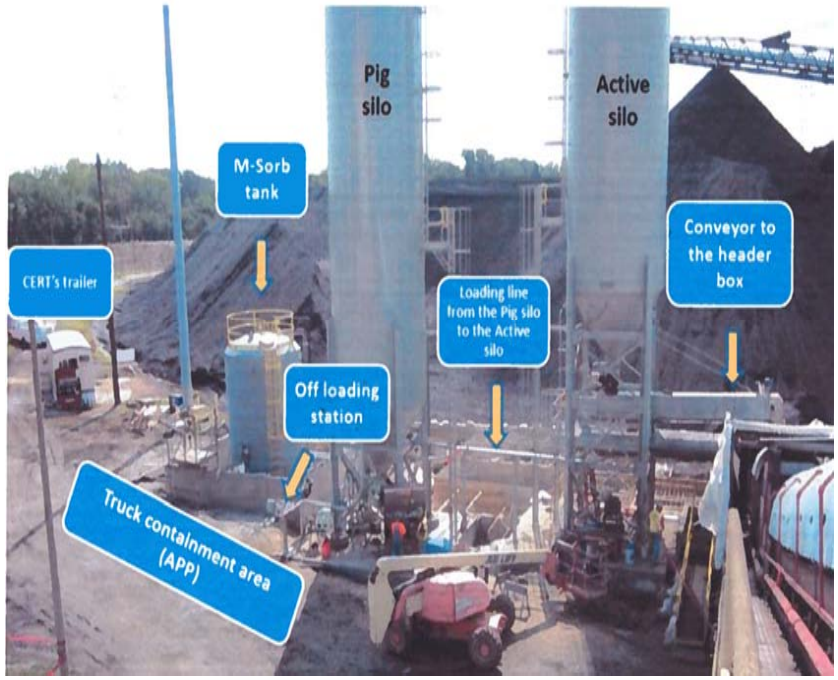
What is Refined Coal?

- Refined coal is an emissions reduction/technology incentive program created under The American Jobs Creation Act of 2004, Internal Revenue Code Section 45
- The IRC provisions are designed to promote development and adoption of new technologies for coal-fired power plants
- Federal tax credit extends through 2021
- Energy & Environmental Research Center at University of North Dakota central to technology development and testing
- Qualifications for Refined Coal:
  - equipment placed in service by December 2011;
  - demonstrated and verified NOx (20%) and mercury (40%) emissions reductions;
  - sold by producer to third party utility (cannot be produced by the utility for its own use)
- Refined Coal conversion takes place as a part of coal-burning power production
- Additive to coal, applied directly to coal pre-combustion

Producing Refined Coal

- Refined Coal is produced through equipment installed at the coal burning power plant
  - Equipment installed in the coal yard, adjacent to the coal belt
  - Equipment footprint is integrated into the power plant's overall coal processing
- Technologies vary, but chemical additives applied directly to coal
- Refined Coal must be produced by an independent party rather than by the utility
- Utility sells raw coal to the Refined Coal producer
- Equipment operated by independent employees engaged by the RC producer
- Post processing, Refined Coal sold to utility for power production

Sample Pictures of Refined Coal Facilities



Refined Coal in North Dakota

- Currently operating at four coal-fired power plants in North Dakota
- 4 locations, in operation since 2009/2011/2013
  - Basin Electric (2 locations)
  - Minnkota
  - Great River
- 2 facilities operated by CCS; 1 by CERT; and 1 by North American Coal

Benefits of Refined Coal to North Dakota

- Reduced NOx and mercury emissions verified by the University of North Dakota EERC
  - Refined Coal production allows plants to reduce mercury in advance of EPA requirements
- Supports the ND lignite economy
  - ND has abundant and accessible reserves of low-cost lignite
  - Thousands of jobs in ND related to production of lignite
  - Economic pressure from natural gas and other technologies
- Improved economics for North Dakota coal-burning utilities
  - Refined Coal producer bears costs
  - Reduced costs for the utilities for environmental compliance
  - Promotes the use of North Dakota lignite
- Direct employment >30 full-time jobs in Refined Coal production
- ***The use of lignite to generate electricity results in lower electricity costs for consumers, farms and businesses in North Dakota***

Current Coal Beneficiation Tax Provisions

- Gross receipts from refined coal transactions between RC operators and utilities are taxed under the coal beneficiation tax provisions (57-60-02(1))
- Tax is generally $.20/ton of refined coal produced
- Currently, state portion (85%) of tax is exempted for a period of five years from the date of first taxable production (57-60-02(5)(a))
- Counties are permitted to exempt remaining portion (15%), however, to date two counties have denied such requests
- Coal beneficiation tax is in lieu of personal property taxes (57-60-06)
- Beneficiated coal is exempt from sales taxes (57-39.2-04(41)) as long as beneficiation taxes have been paid
- Coal beneficiation taxes are uncommon
  - Most other states assess a property tax based on the cost of the Refined Coal equipment located adjacent to the Utility

Proposed Legislative Action

We are proposing that the coal beneficiation tax language be modified so as to exempt coal conversion facilities owned and operated by third parties that reside within the "fence" of a Utility where the "beneficiated" coal is burned to generate electricity.

Coal still subject to severance tax.

Overall power plant process still subject to conversion tax.

Selected Refined Coal Producers

- Coal Emissions Reduction Technologies, LLC (CERT)
  - Birmingham, AL
- Clean Coal Solutions, LLC (CCS)
  - Denver, CO

Questions?