

Studies to Evaluate Value-Added Market Opportunities for North Dakota

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

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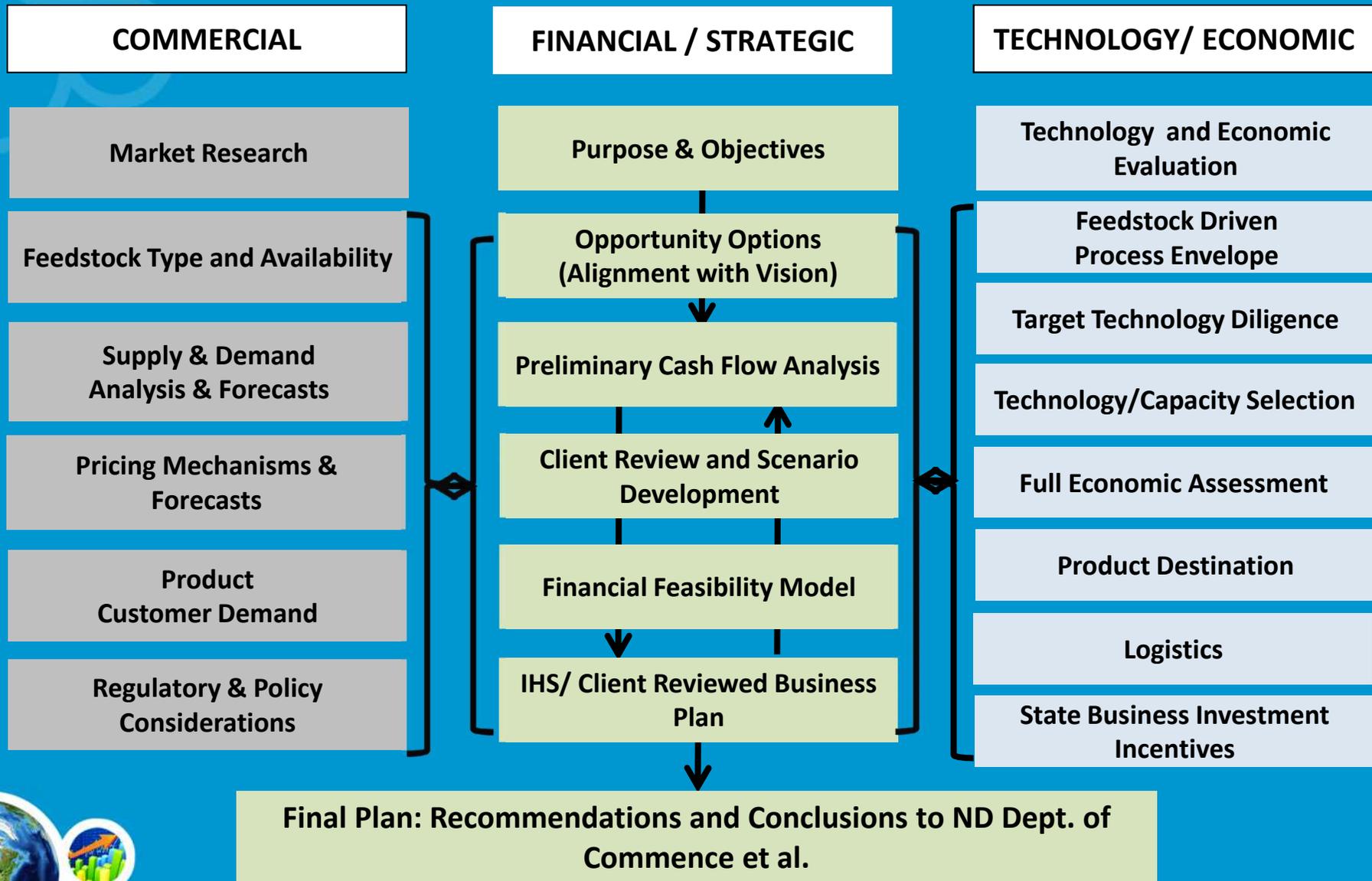
Bismarck, North Dakota



IHS Chemical

Studies to Evaluate Value-Added Market Opportunities for 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

Studies to Evaluate Value-Added Market Opportunities for North Dakota



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



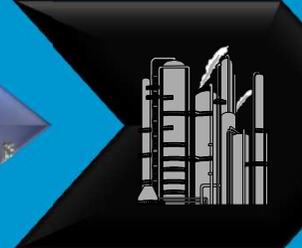
Oil Refining and Gas Processing

Monomer/Base Chemicals



Separation, Conversion

Derivatives & Intermediates



Conversion

Plastics & Rubber



Polymerization



Customers



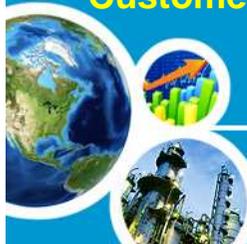
Retail



Manufactured Goods



Converters: Tires and Other Fabricated OEM Parts



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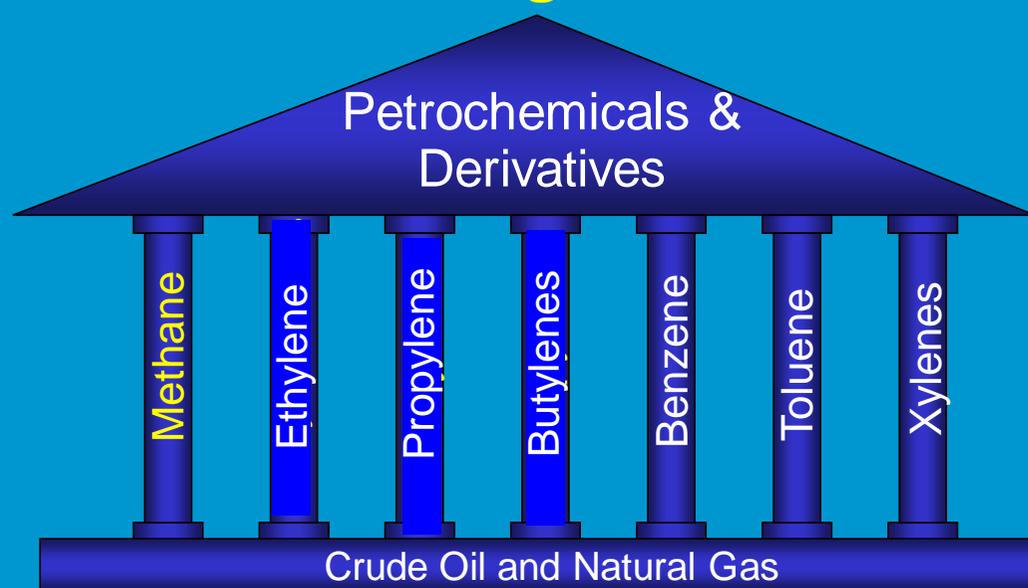
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The Fabricated Products are Diverse and Familiar

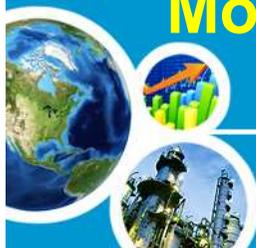


Petrochemical Building Block Chemicals

- 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

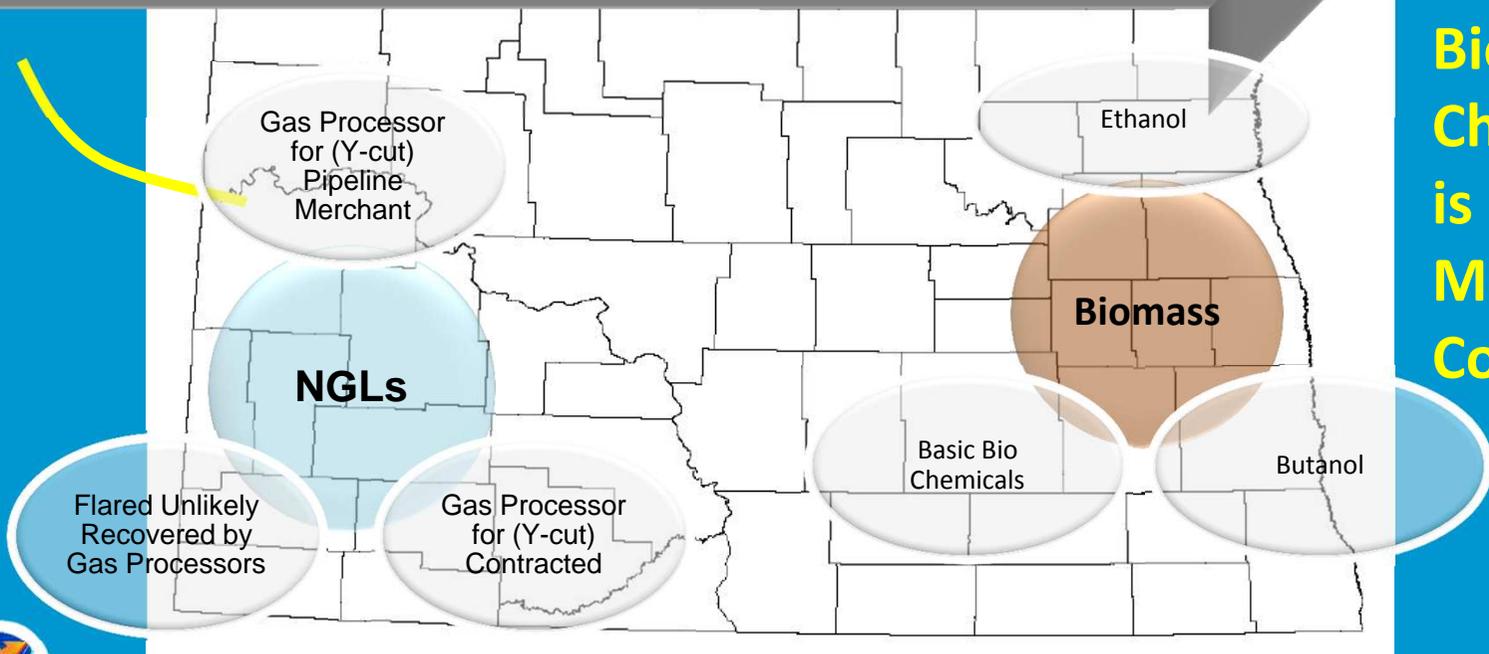


Most petrochemical derivatives can be traced back to one or more of these building blocks



The Feedstock-Product Value Chain

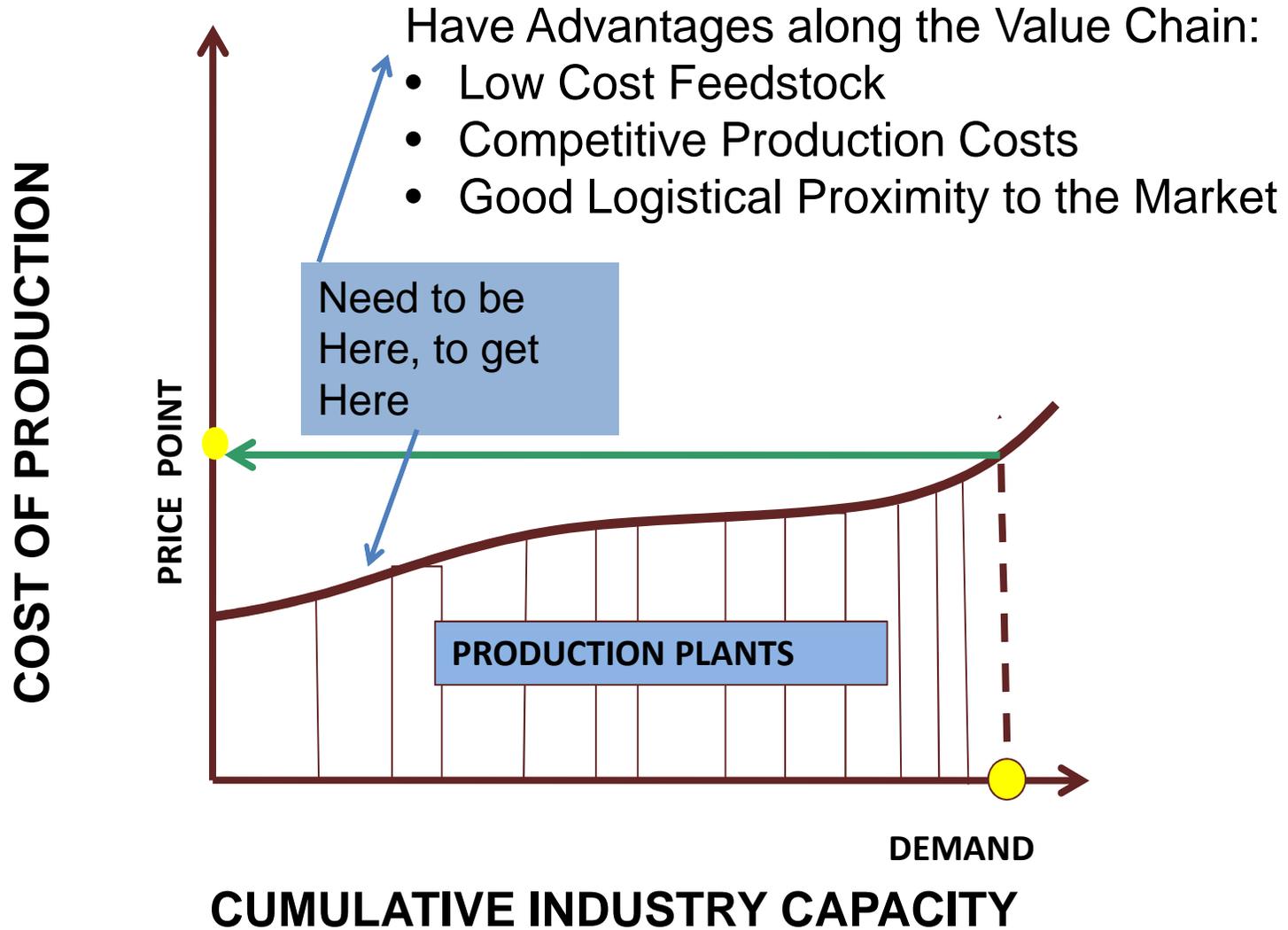
To be Advantaged here,
You Need to be Advantaged
here



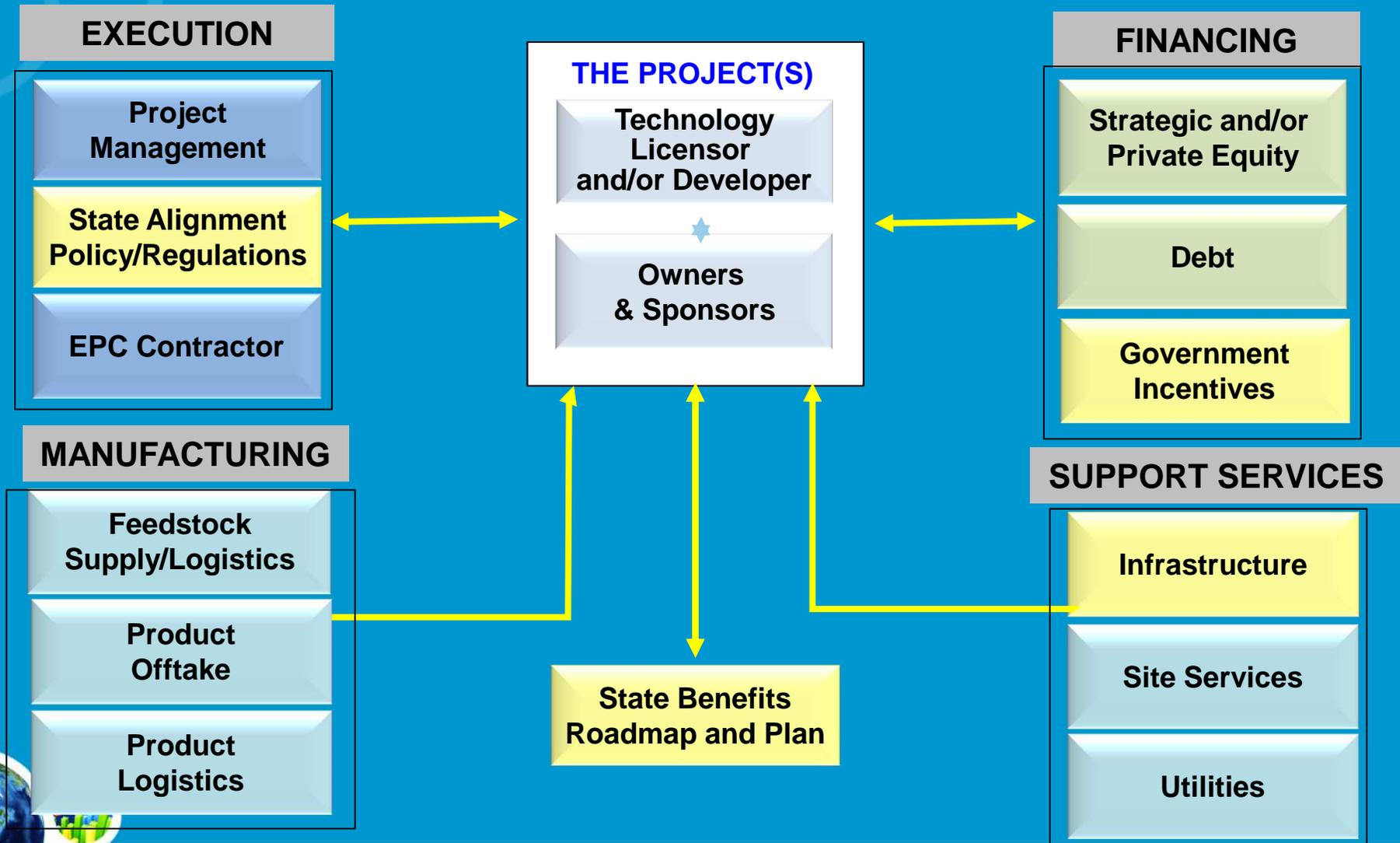
**Bio-based
Chemistry
is
More
Complex**



Fundamentally, the Industry Cost Curve Dictates Success



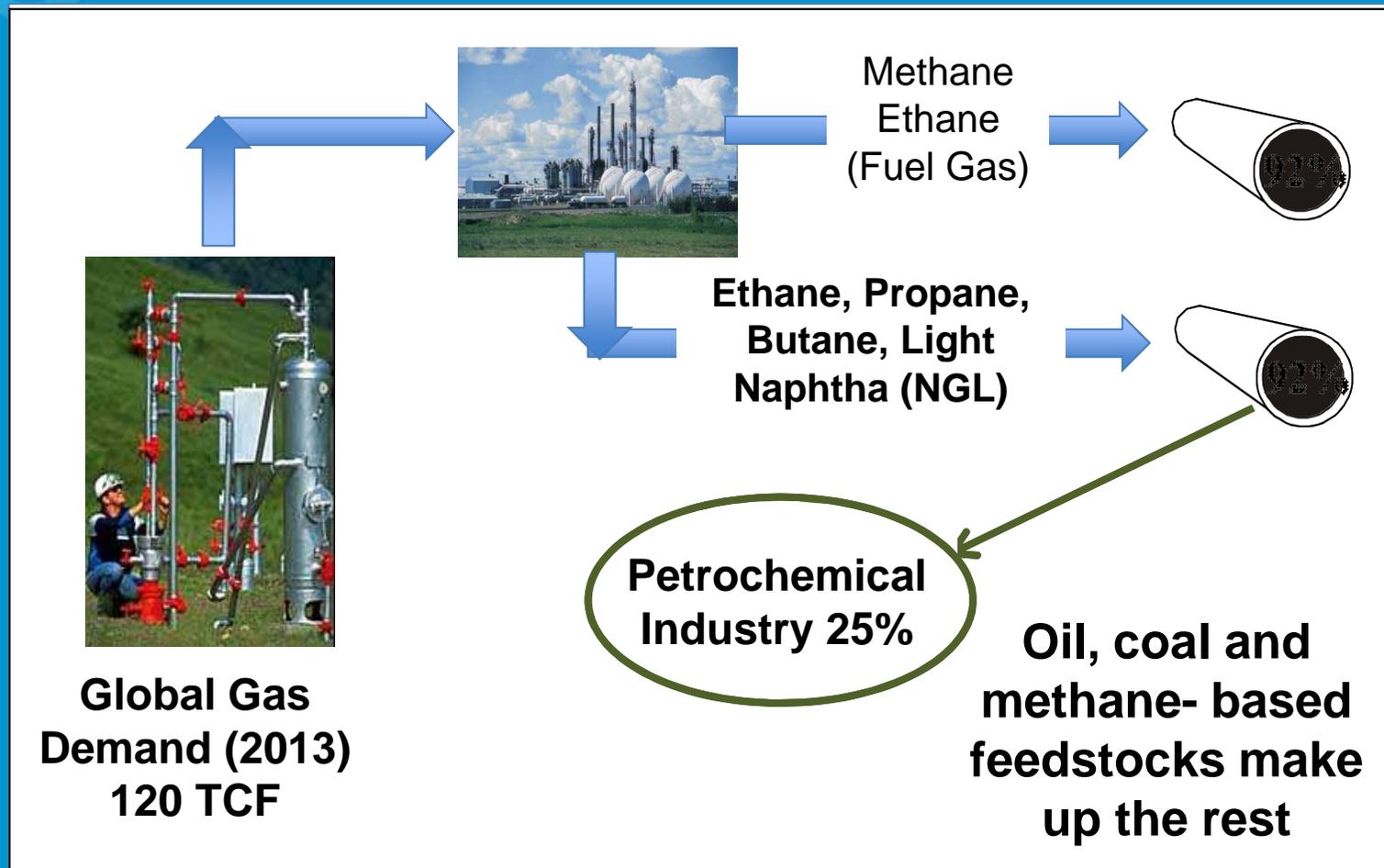
To Be Successful, Project Development Must “Execute” all the Fundamental Aspects



Adding Value to the Bakken NGLs

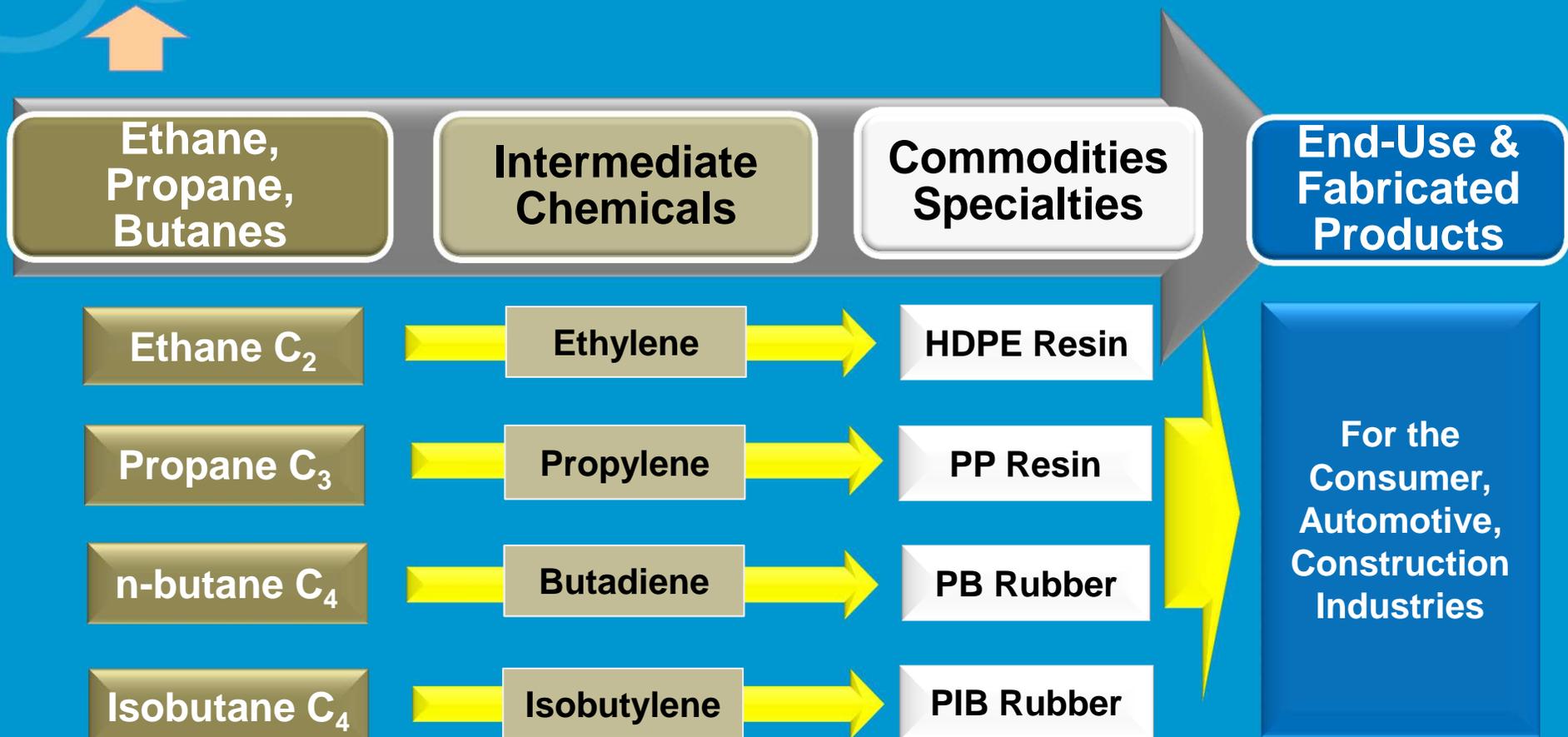


Why is there an Opportunity to Add Value to the Bakken's Hydrocarbons



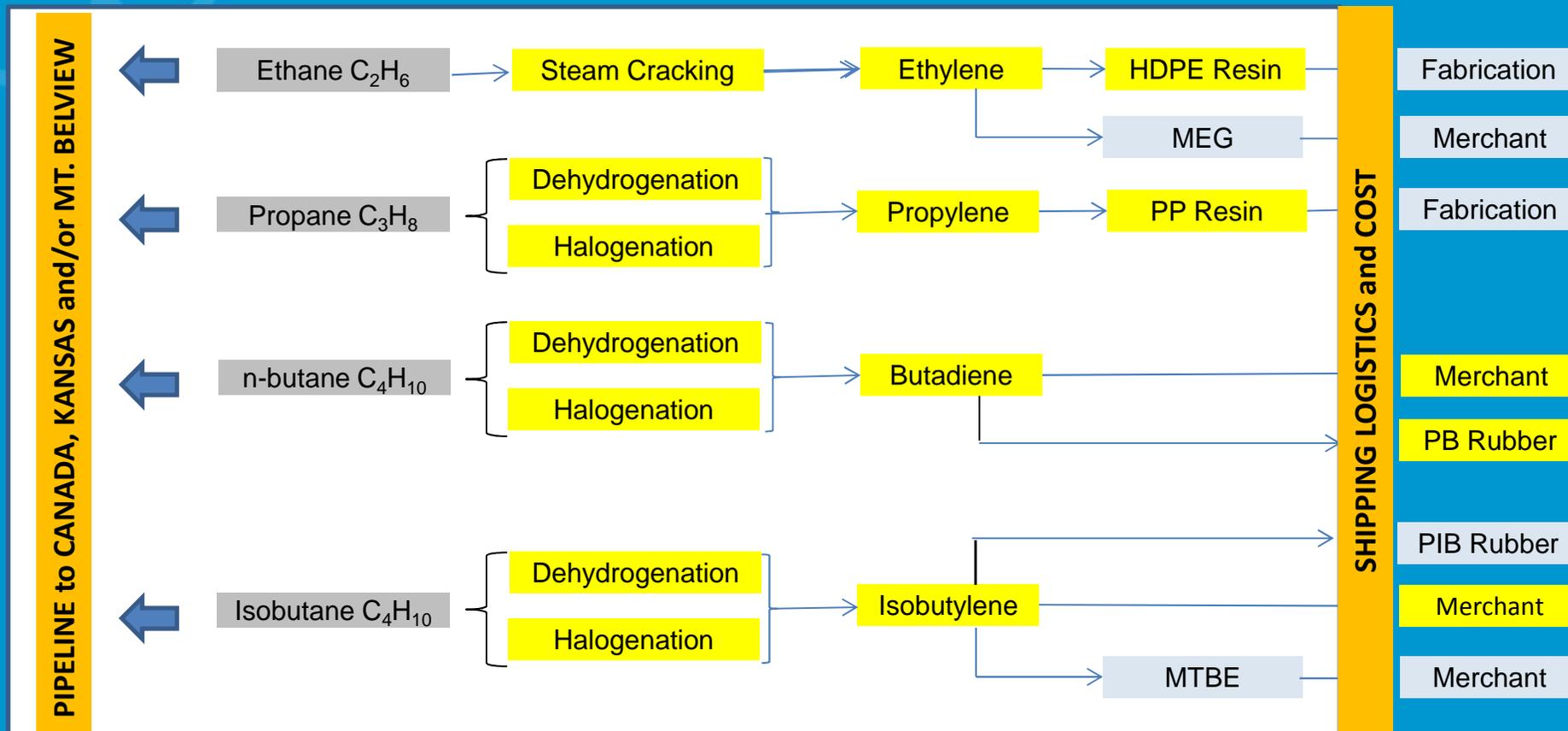
The Likely Value-Add Opportunities for the Bakken

Currently to Pipeline and Fuels



NGLs to Chemicals: Economic Screening

Indicates Opportunity



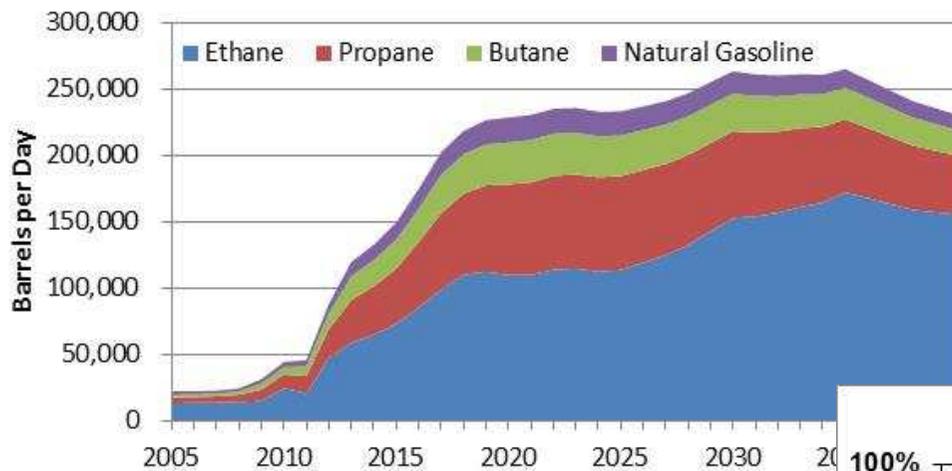
NGLs to Chemicals: Capacity and Capital Costs – North Dakota - 2020 Basis

NGL - Feed Requirements			NGL		
	KMT	Bbl/day		Capacity, kMT	Capital, USMM\$
Ethane Feed - HDPE	520.90	27781	Ethane Cracker - HDPE	404.00	939.00
Ethane Feed - MEG	297.90	15888	Ethane Cracker - MEG	231.00	635.00
Propane Feed - PDH	563.30	21166	HDPE	400.00	309.00
Propane Feed - Halogenation	497.30	18686	EO	304.00	727.00
n-Butane Feed - BDH	512.40	16769	MEG	400.00	197.00
n-Butane Feed - Halogenation	348.10	11392	Propane Dehydrogenation (PDH)	467.00	1191.00
i-butane - BDH	152.50	4852	Propane Halogenation	467.00	758.00
i-butane - Halogenation	134.70	4286	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

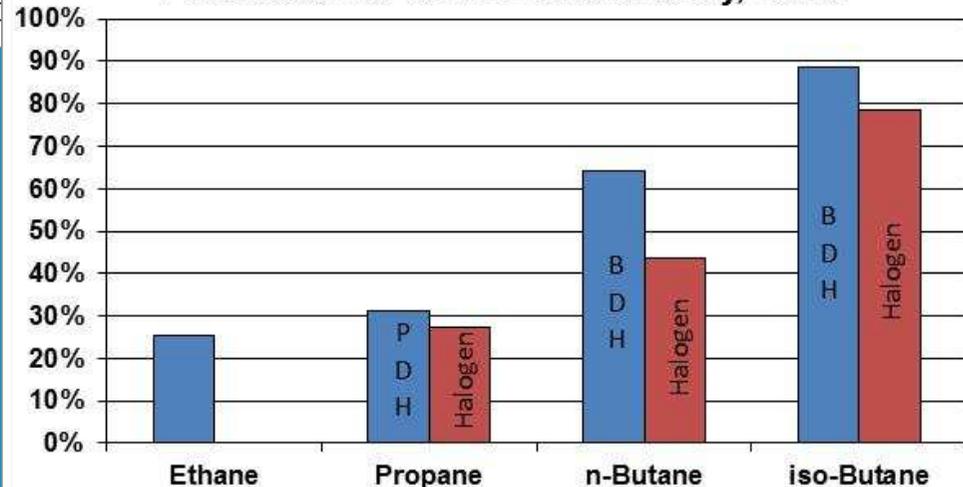
North Dakota NGL Production by Type



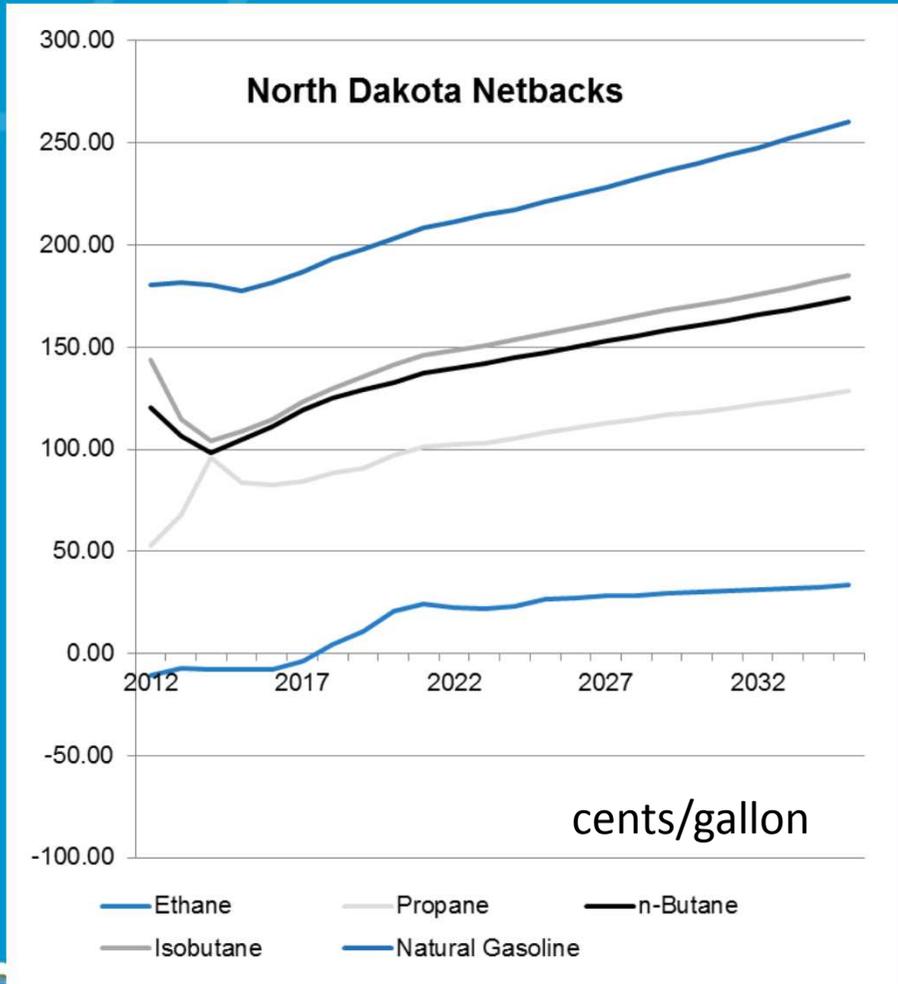
Even with IHS' conservative estimates, the availability situation for competitive-scale petrochemical plant is promising

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

Feedstock % of NGL Availability, 2020



North Dakota Netback Prices



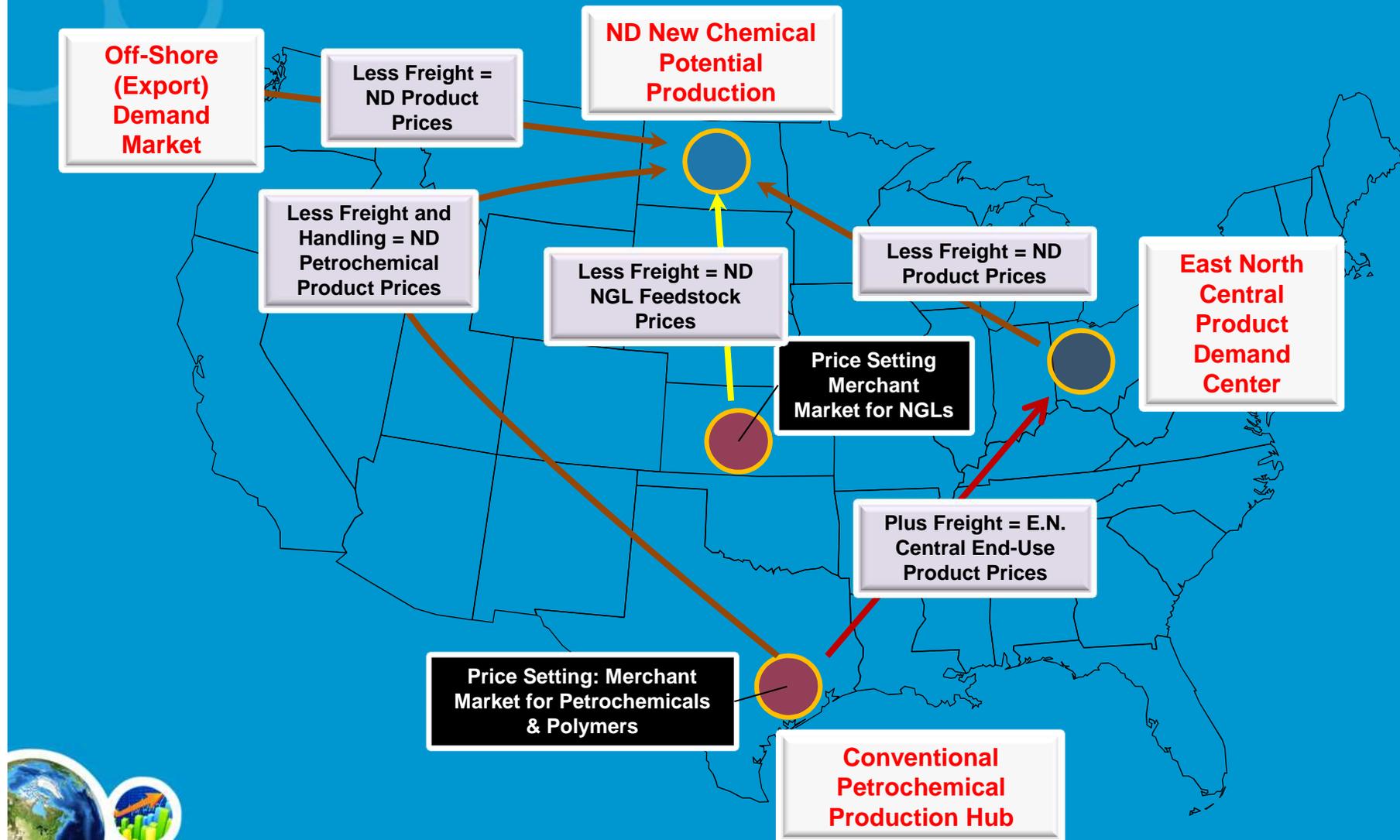
- North Dakota netbacks based on Conway less transportation & separation costs.
- Prices are expected to gradually rise over the next 25 years.

Source: IHS CERA, Statistics Canada, OPIS

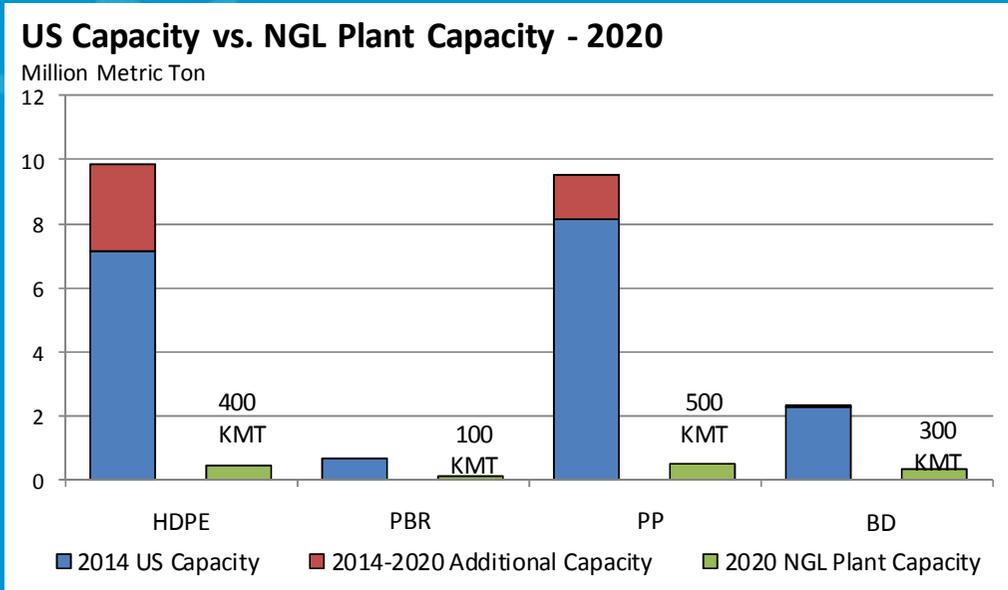
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Product and Feedstock Prices Setting Mechanisms for North Dakota



Proposed Plants Would be a Small Percentage of US Capacity

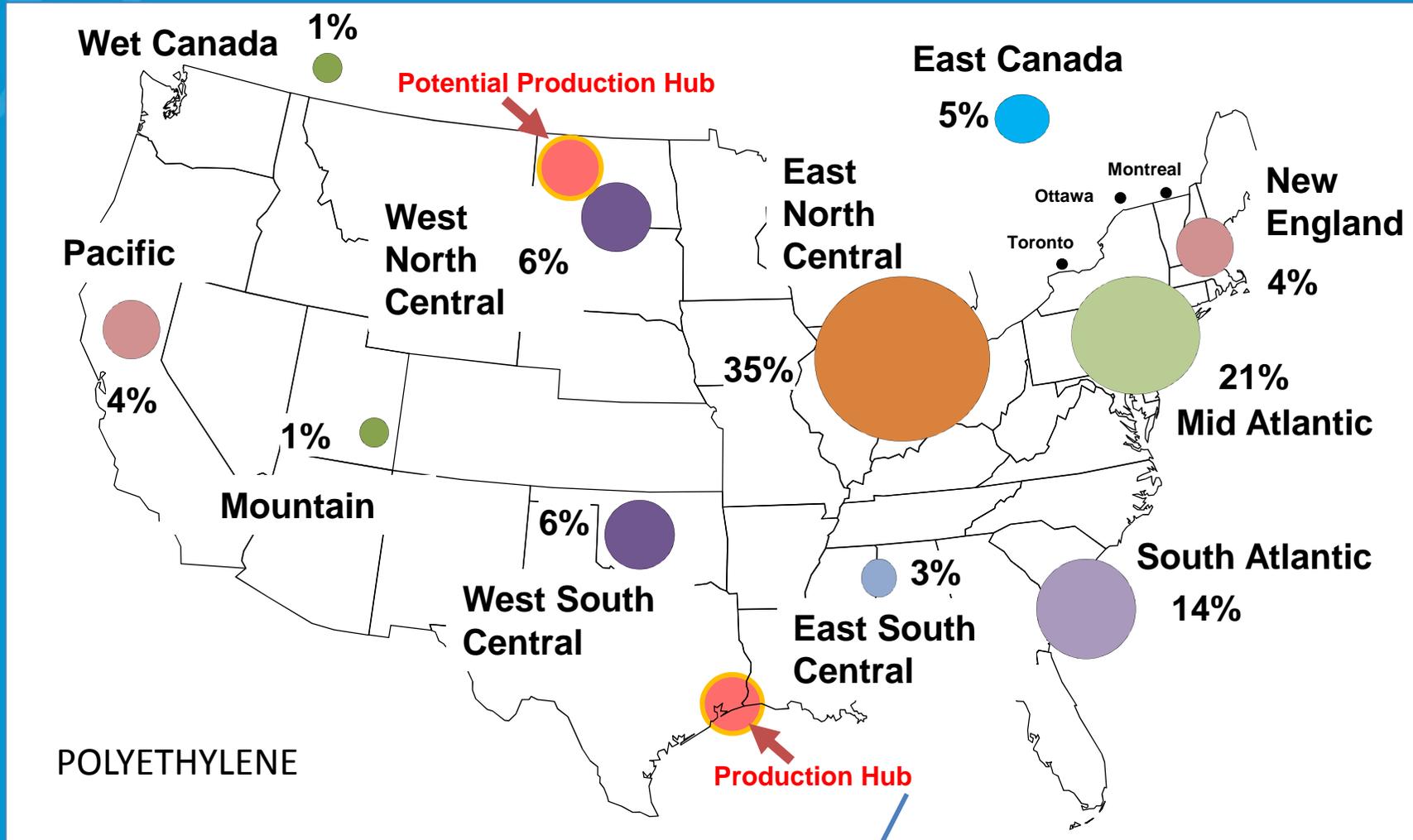


- **The HDPE and PP plants represents a small percent of total capacity in the US in 2020 and of the required capacity addition required to satisfy US supply/demand dynamics**

- **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**



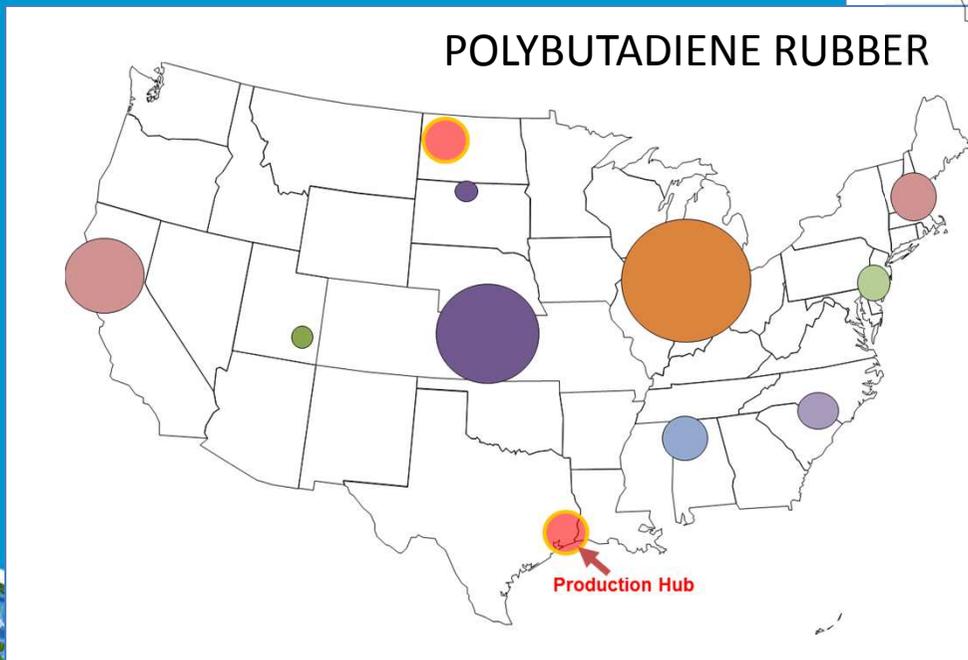
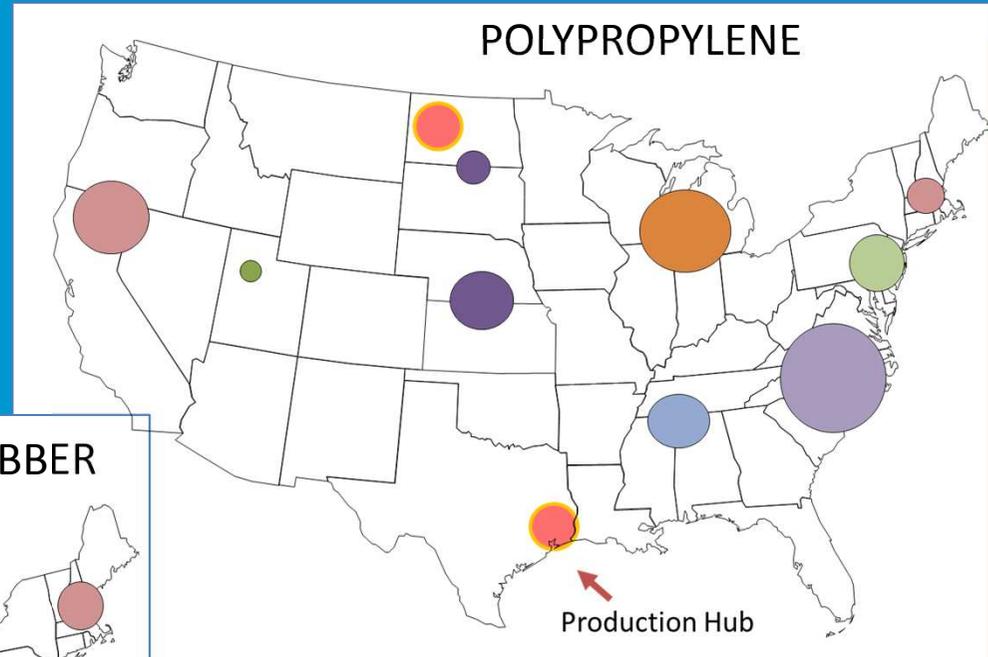
More than half of the PE consumption in US is within reach of a North Dakota Plant



Most of the production is centered in the Gulf Coast



The Proximity Situation is the Same for Other Commodity Polymers



The Value of Basic Feedstock Typically Increases Down the Supply Chain



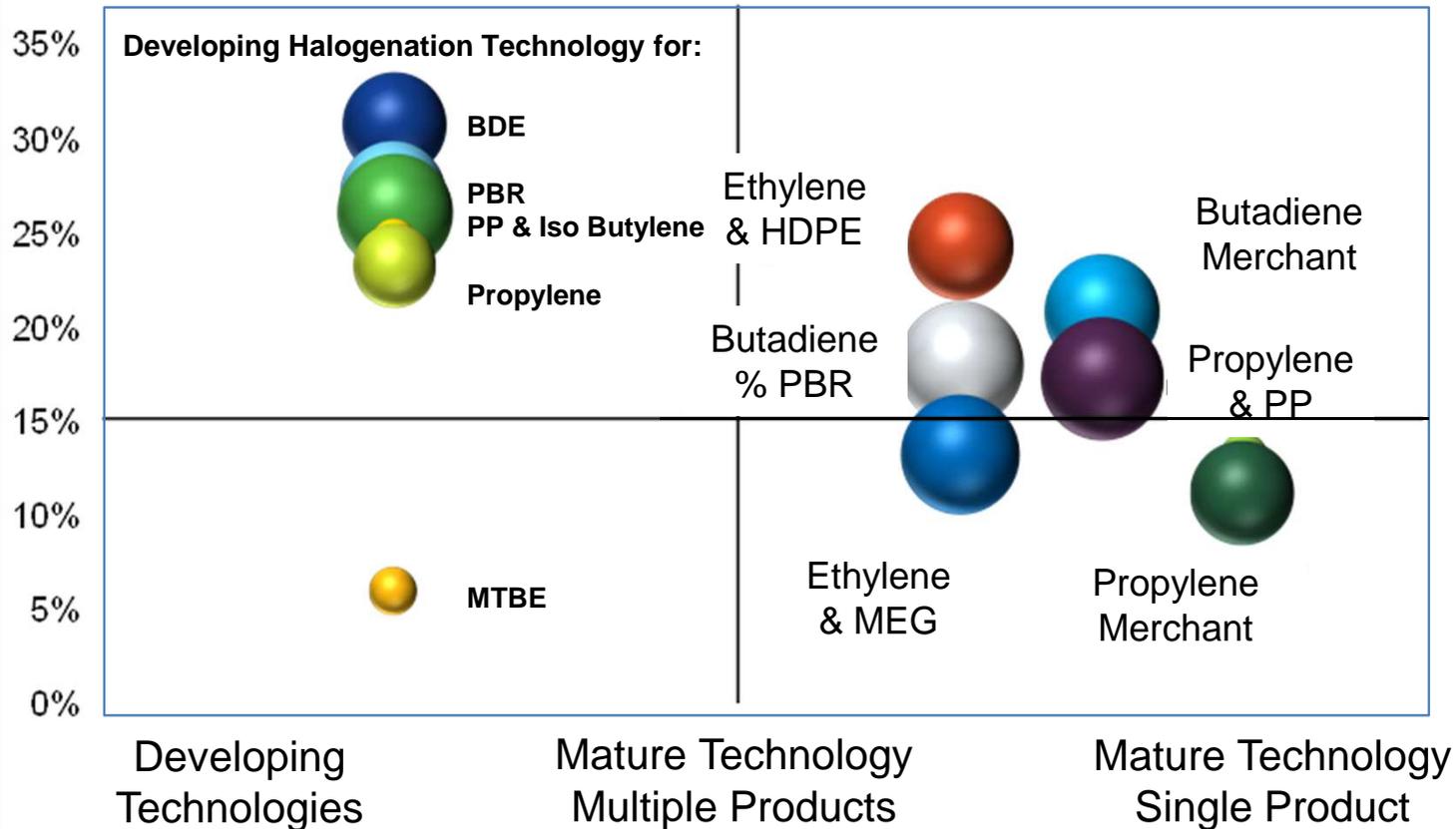
	Ethane	Ethylene	HDPE
Volume (T)	1	1.29	1.30
Value (\$/T)	197 (27c/gal)	938	1507
----- Combined	Ethane	Equivalent	-----
Value in product (\$/T)	197	727	1157
Capacity (KT/YR)	27,500 bpd	404	400 (880 mm lb/yr)
Investment (MM USD)		940	310
Return IRR (%)		21%	24%

Capital and operating cost at each step generate the value increase



Advantages for the North Dakota Translate in Value-Add Opportunities

NGL: Returns (IRR, %) vs. Risk



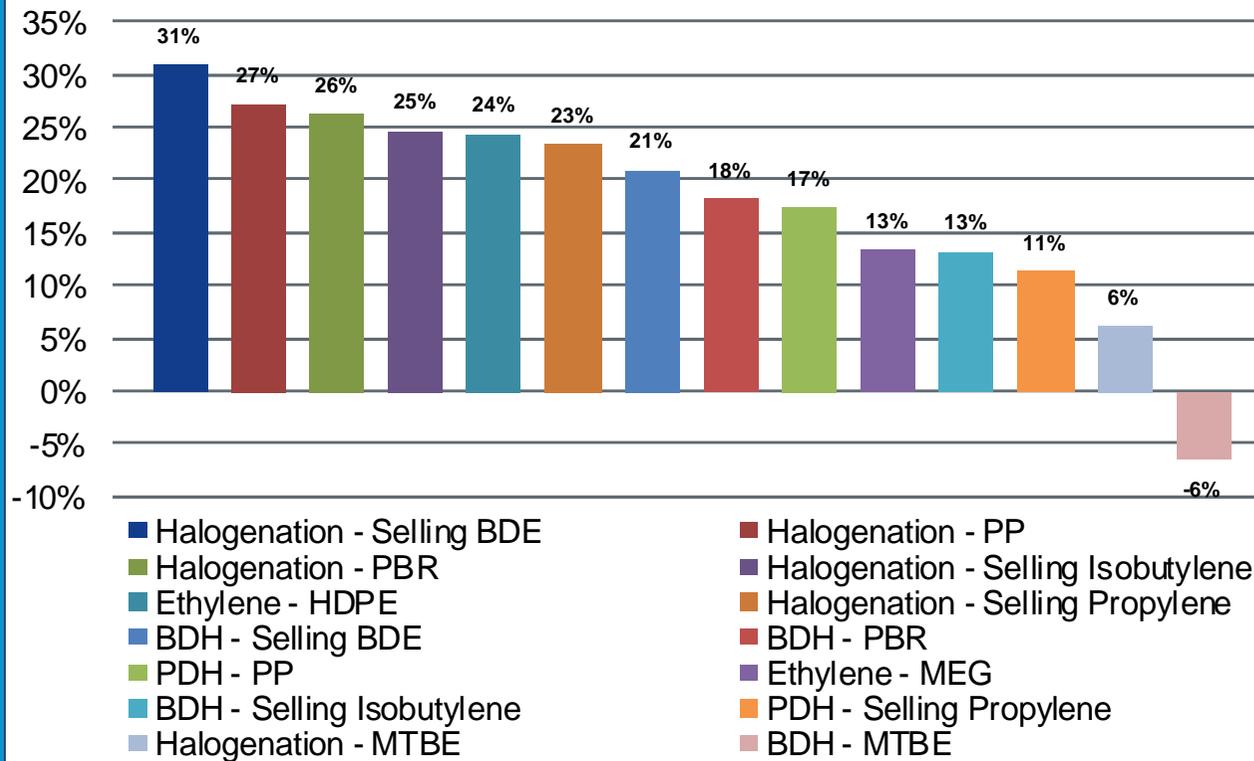
Source: IHS

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Financial Model Results – for NGL Derivatives

NGL: IRR, %



Source: IHS

© 2014 IHS



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
	Full conversion to PlantBottle™ Packaging by 2020 to diversify away from fossil fuels and reduce the Coca Cola System carbon footprint.
	Use packaging materials derived from renewable sources to reduce carbon footprint
	Develop and use packaging materials made from sustainably managed renewable resources such as bioplastics
	Reduce packaging footprint through the use of renewable sources (such as a 100% plant-based PET bottle)
	Use 100% renewable or recyclable materials in all products and packaging
	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).

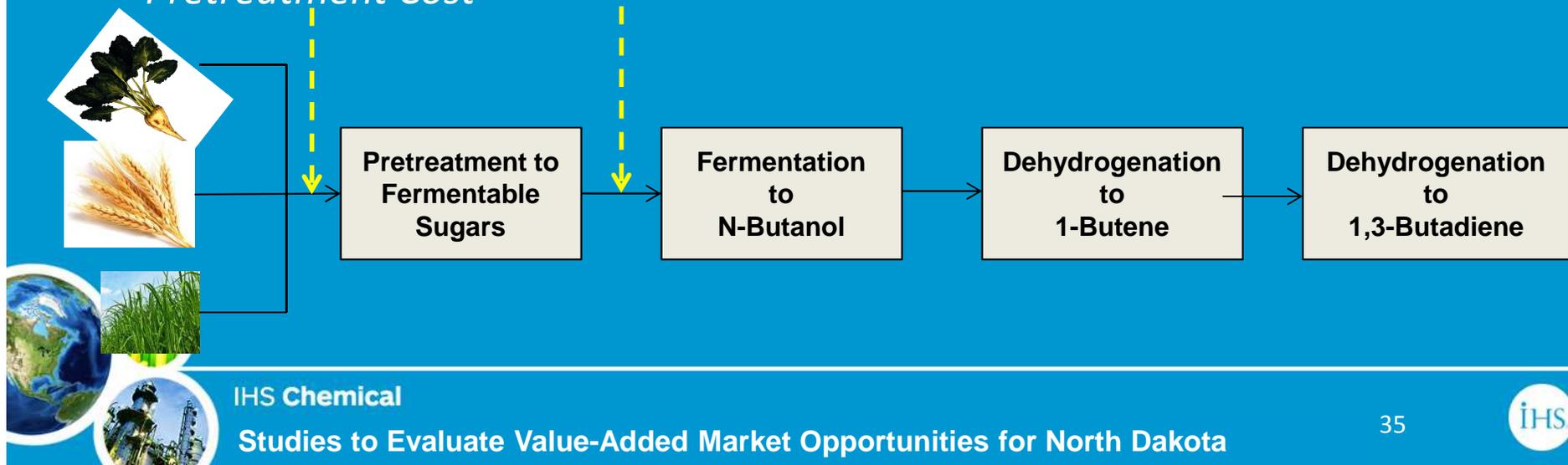


Basis and Assumptions for Alternative (to Corn) Biomass Analysis (continued)

- 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

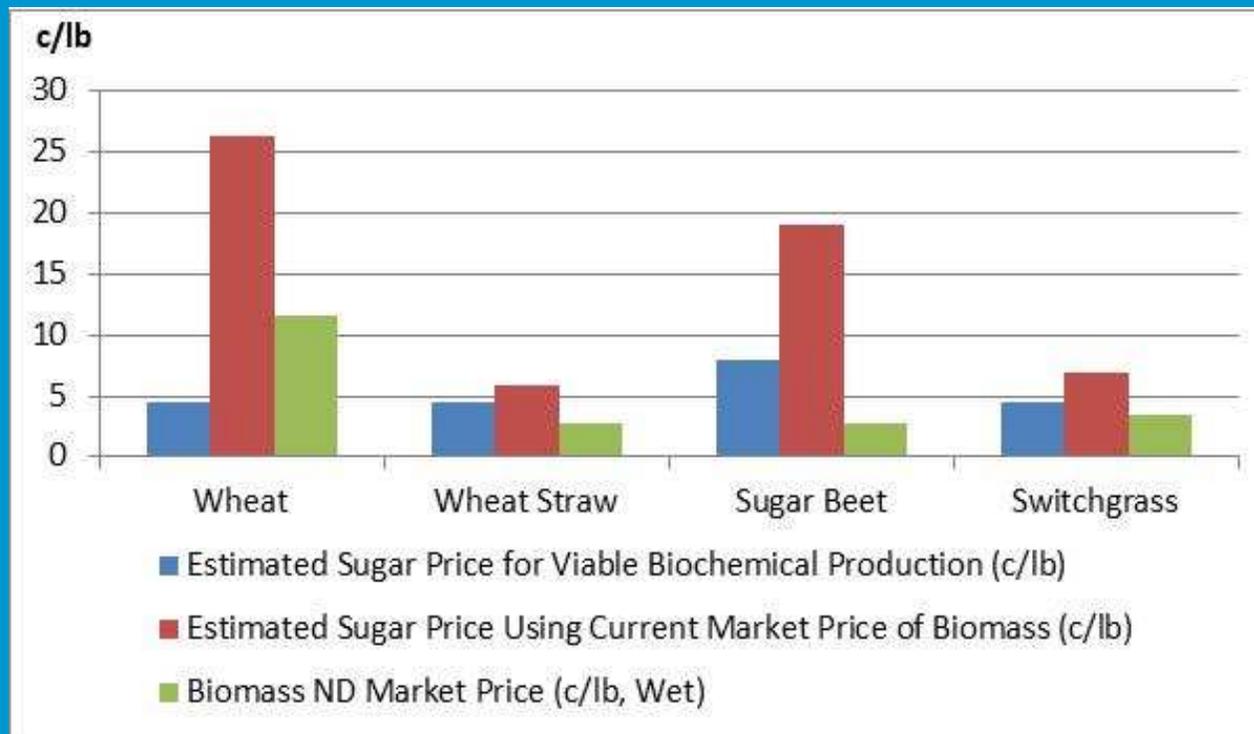
**NOT
ECONOMICAL
for the FARMER**

**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.....



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

C ₁ S	Methanol	PMMA/POM
C ₂ S	Ethanol, Glycolic Acid	PGA, PE, EPDM, PS, PET
C ₃ S	Propanol, Lactic Acid	PP, EPDM, PLA
C ₄ S	Succinic Acid, Butanol, BDO	Butadiene, PBT, TPU, PMMA, PBS
C ₅ S	Isoprene	SIS/SEPS, Elastomers
C ₆ S	Glucaric/Adipic Acid, Isosorbide	PA 66, Green-PC
Aromatics	PX, benzene	PS, PET
C ₈ +	Functional Chemicals	Specialty Chemicals

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

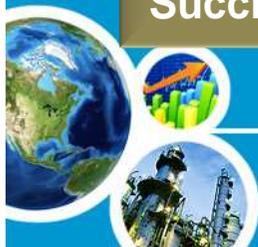
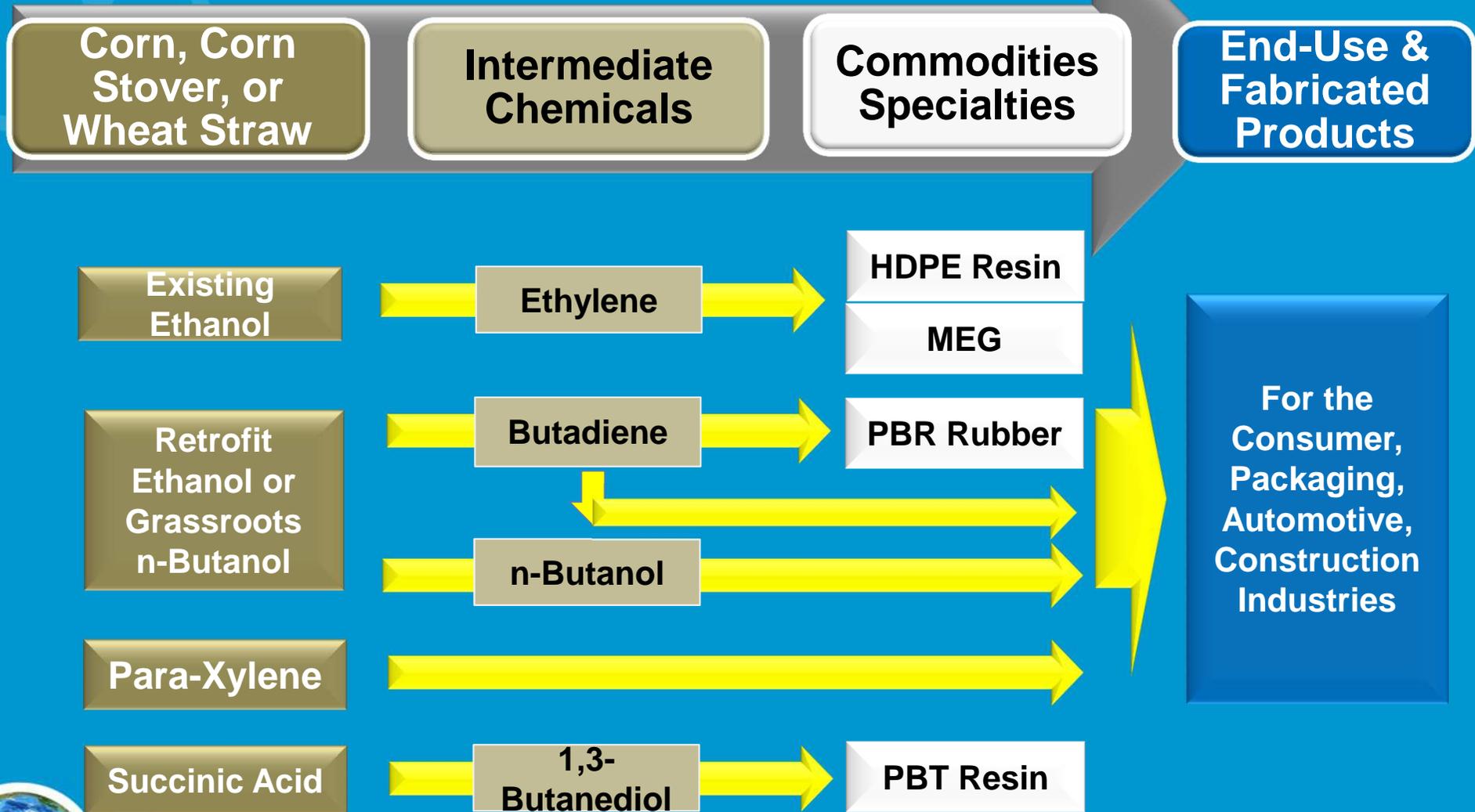


Bio-based Commodity Plastics Have a Limited Application at Premium Prices

- **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

Unit	Bio		
	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	



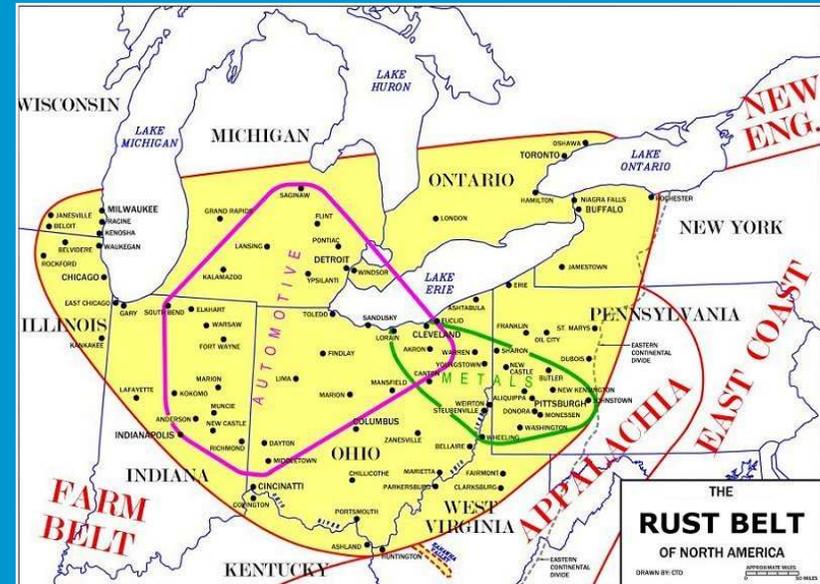
The Rust Belt is a Likely Destination for Products Produced in North Dakota

- This geographical sector also includes the center of the US automotive industry, as indicated in the map:

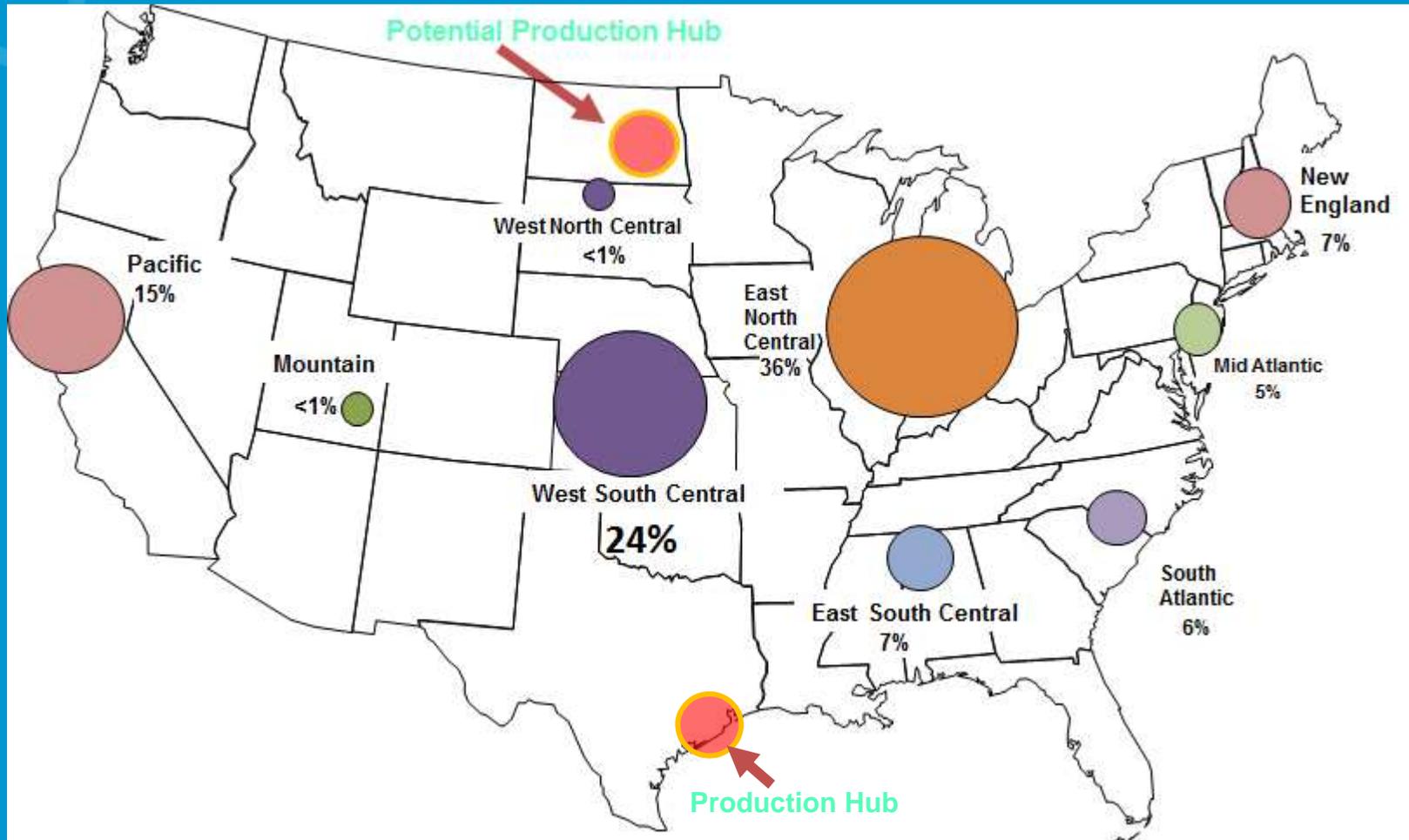
Michigan, Ohio and Indiana

- 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*)

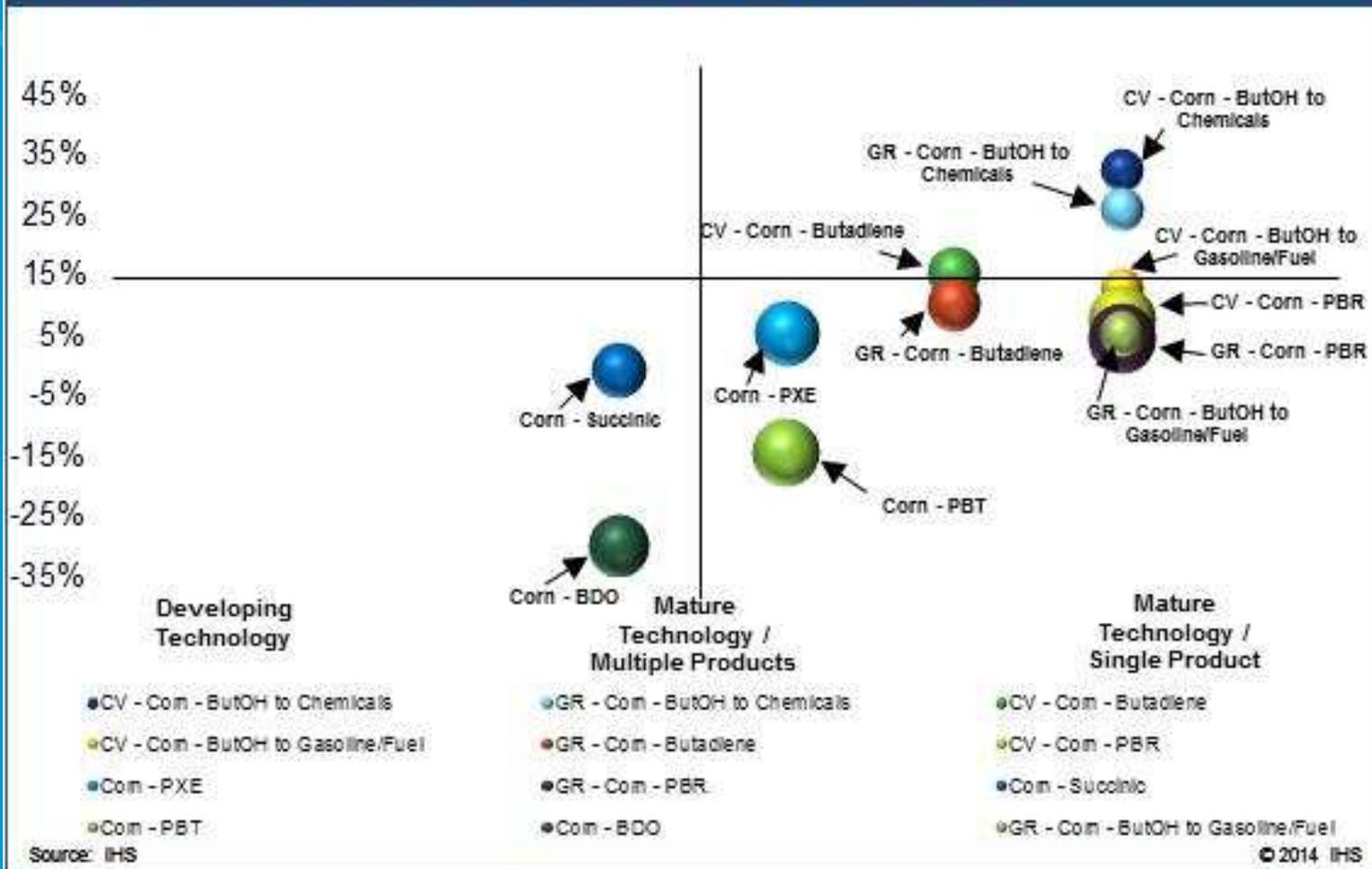


More than half of the consumption in US is within reach of a North Dakota Plant, while most production is centered in the U.S. Gulf Coast



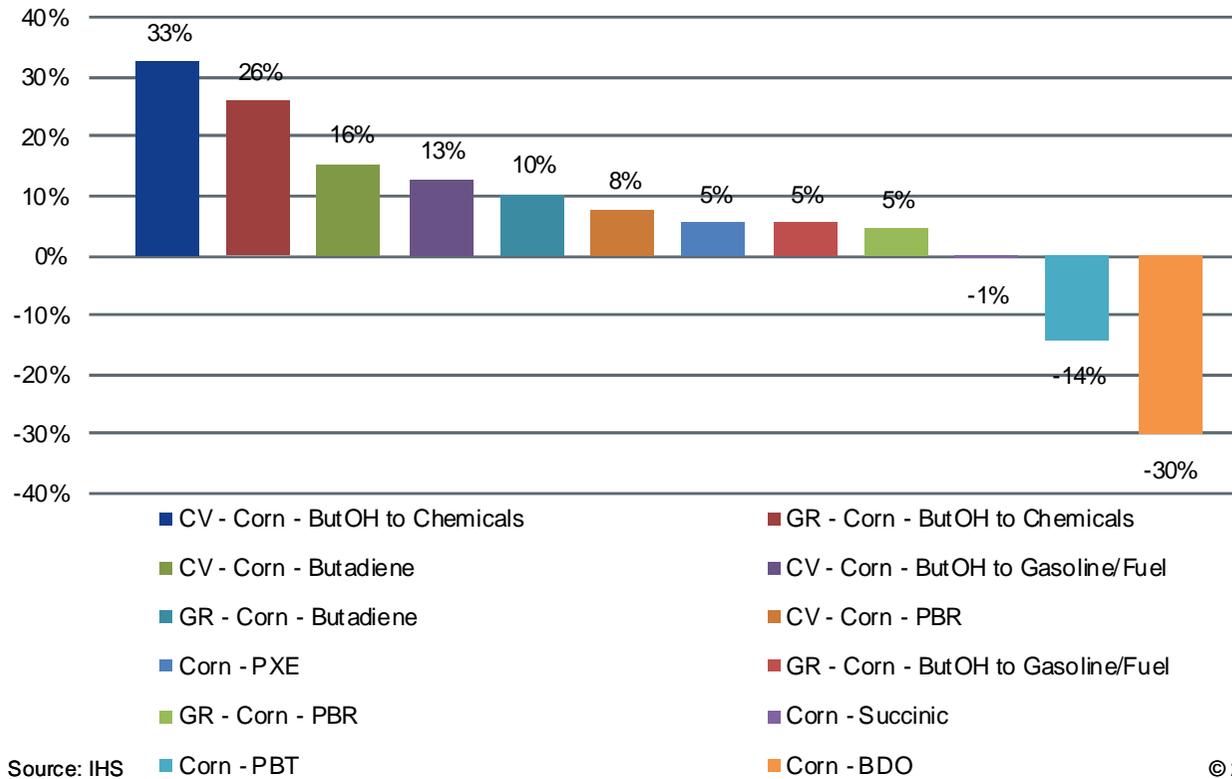
Financial Model Results (Corn Based)

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



Financial Model Results (Corn Based)

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



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

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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

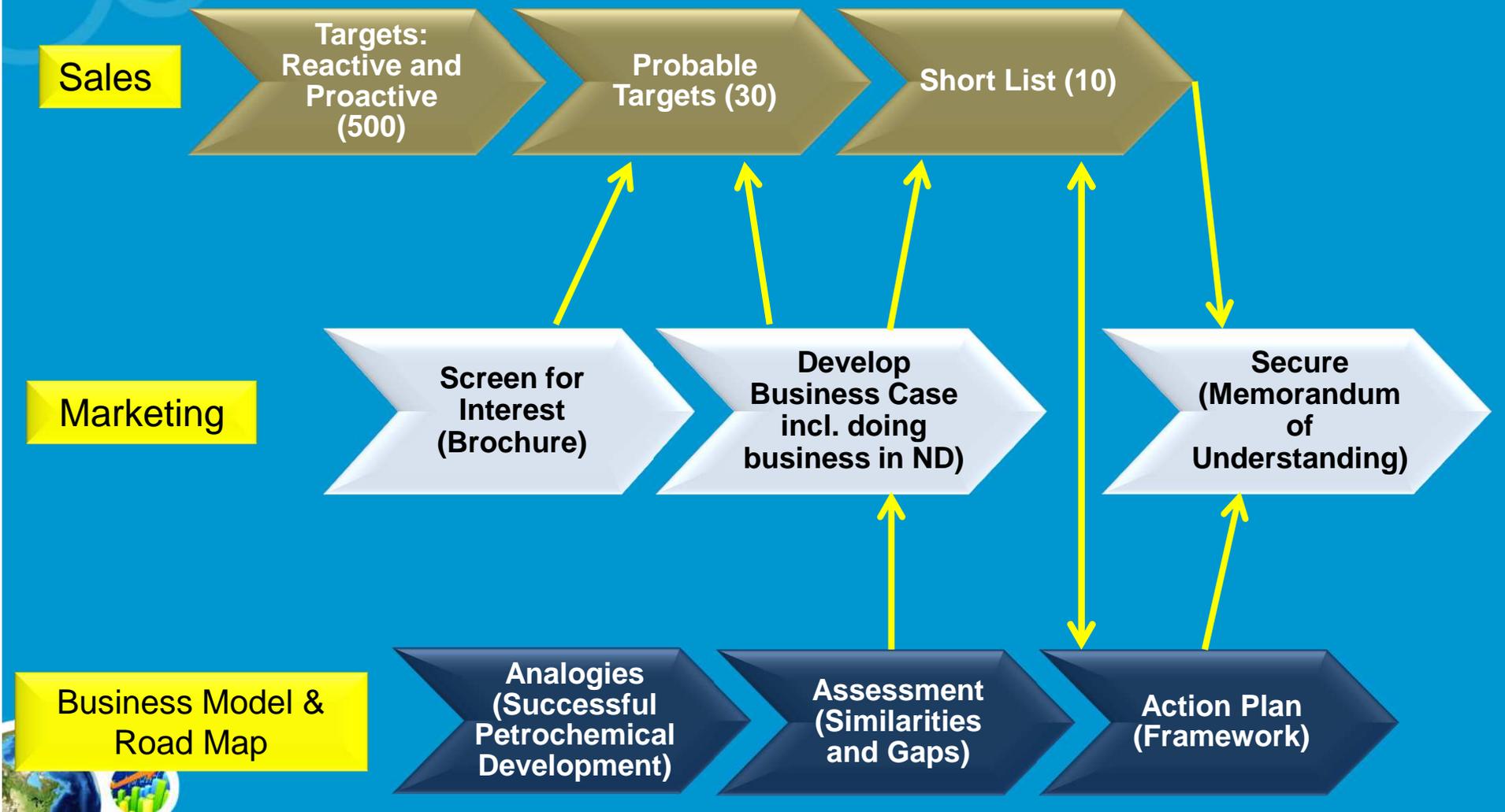


Post-Study Steps

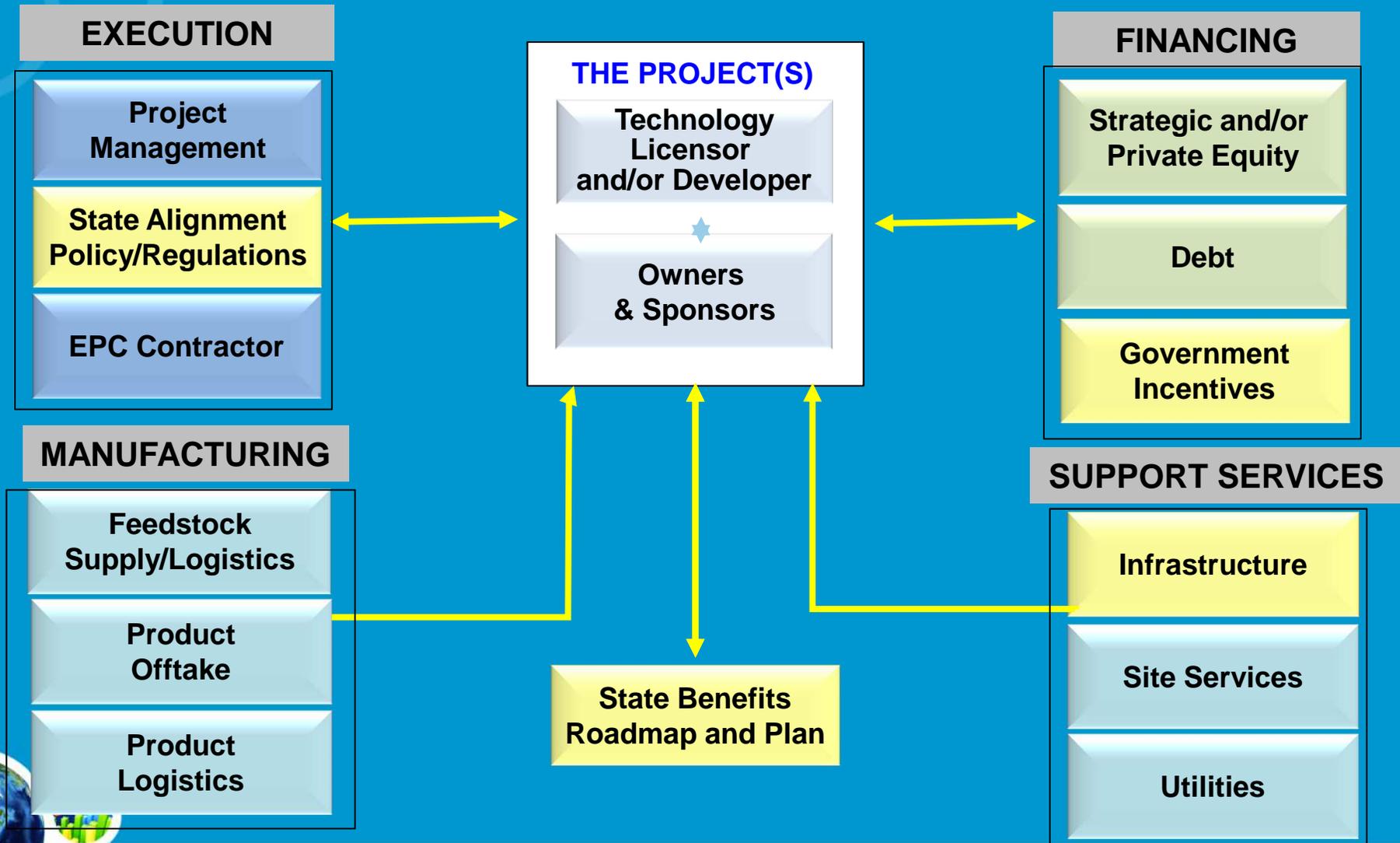
- **Develop Business Plans and Solicit Investors (sales and marketing)**
- **Development of Master Plan**
 - Effect of investment on the state
 - State project development benchmarking
 - Develop and 5, 10 and 15 year roadmap based on investor interest
 - Infrastructure and transportation logistics required 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 policies and legislation on the social, fiscal and environmental impacts of various development projects**



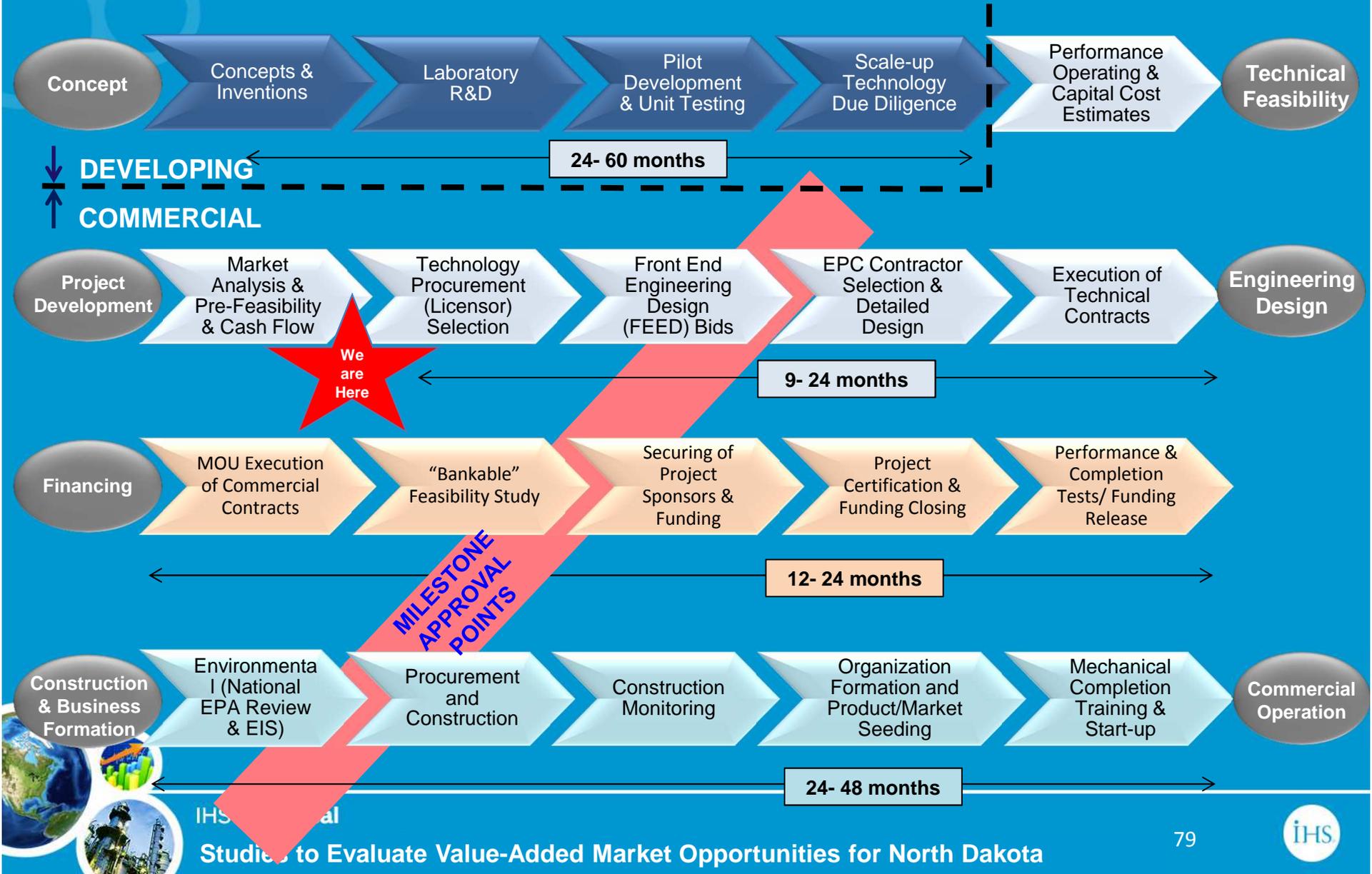
A Task Force(s) Need to Manage the NGLs and Ethanol Value-Add Initiatives



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



IHS Chemical

Studies to Evaluate Value-Added Market Opportunities for North Dakota

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