

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**



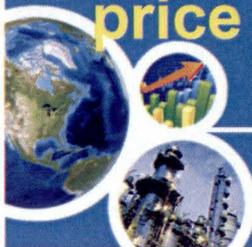
Potential for Ethanol as a Petrochemical Feedstock

- 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

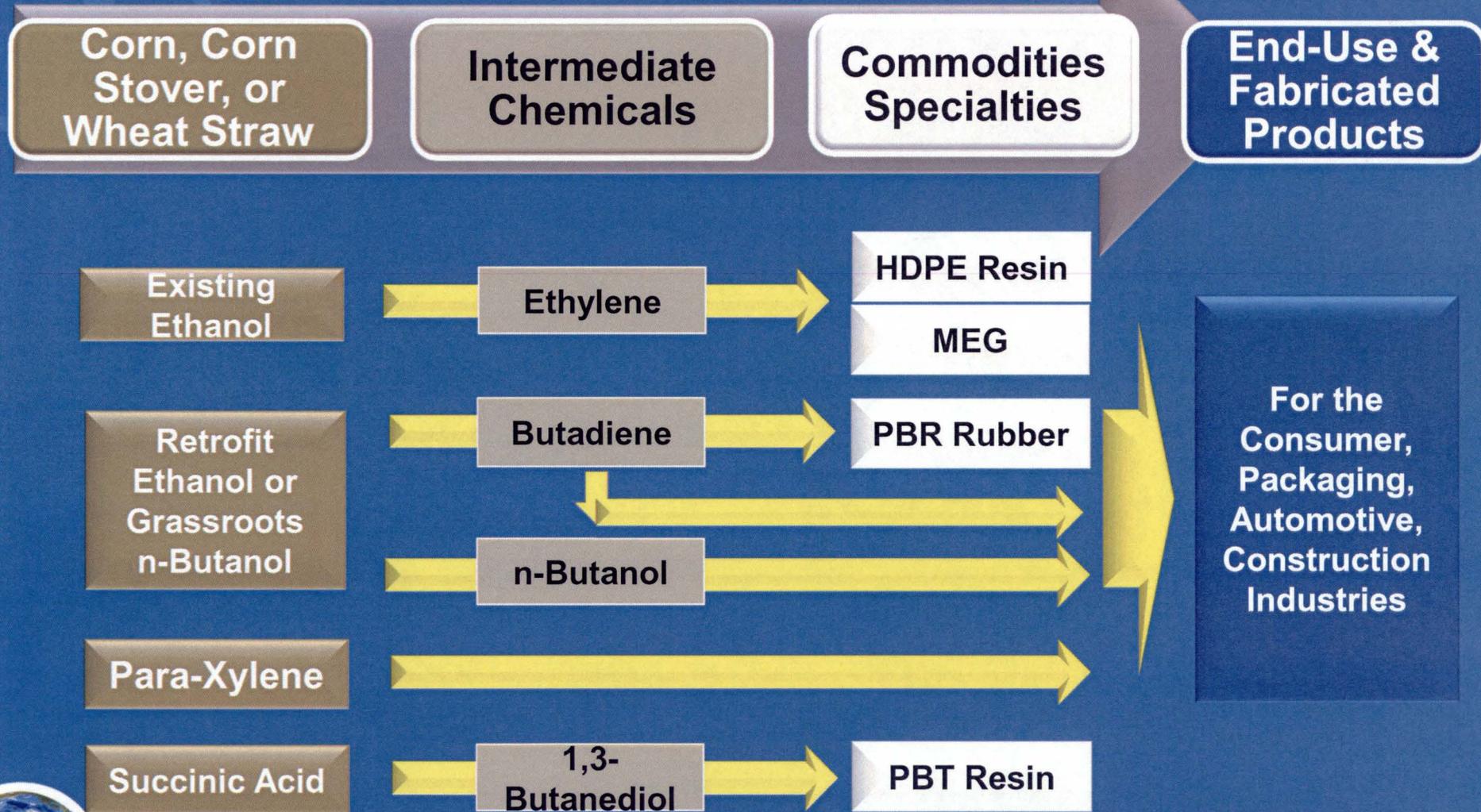


Bio-based Commodity Plastics Have a Limited Application at Premium Prices

- 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



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

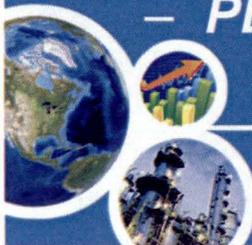
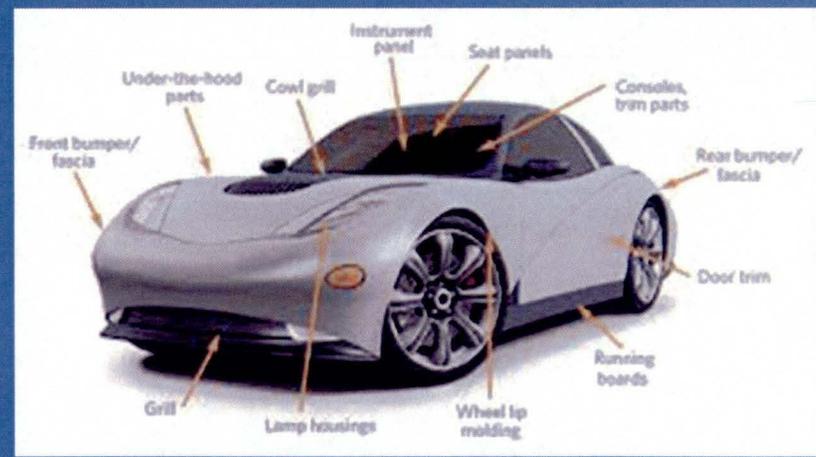
- This geographical sector also includes the center of the US automotive industry, as indicated in the map:

Michigan, Ohio and Indiana

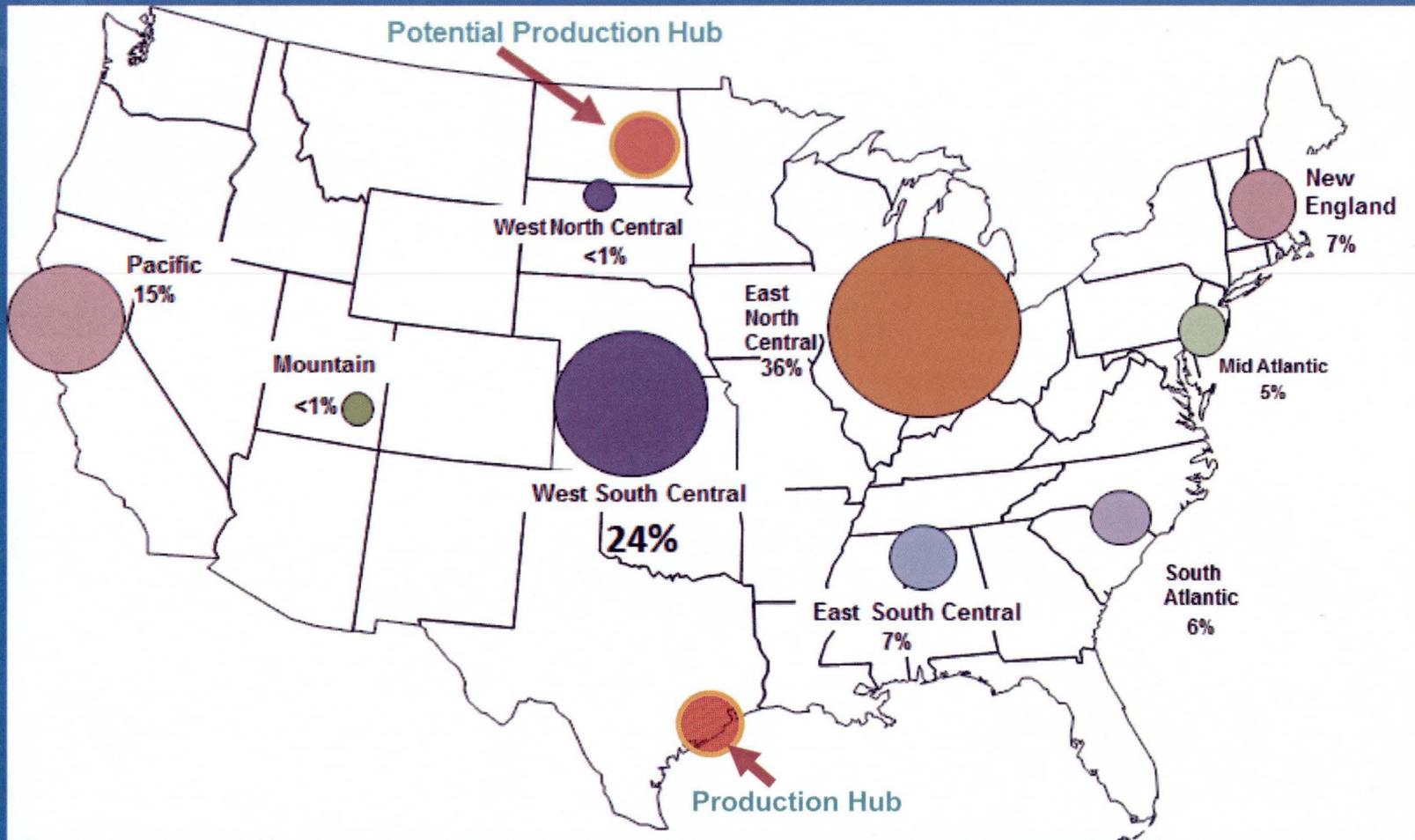
- The automotive industry uses products targeted in our study:

- *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*)

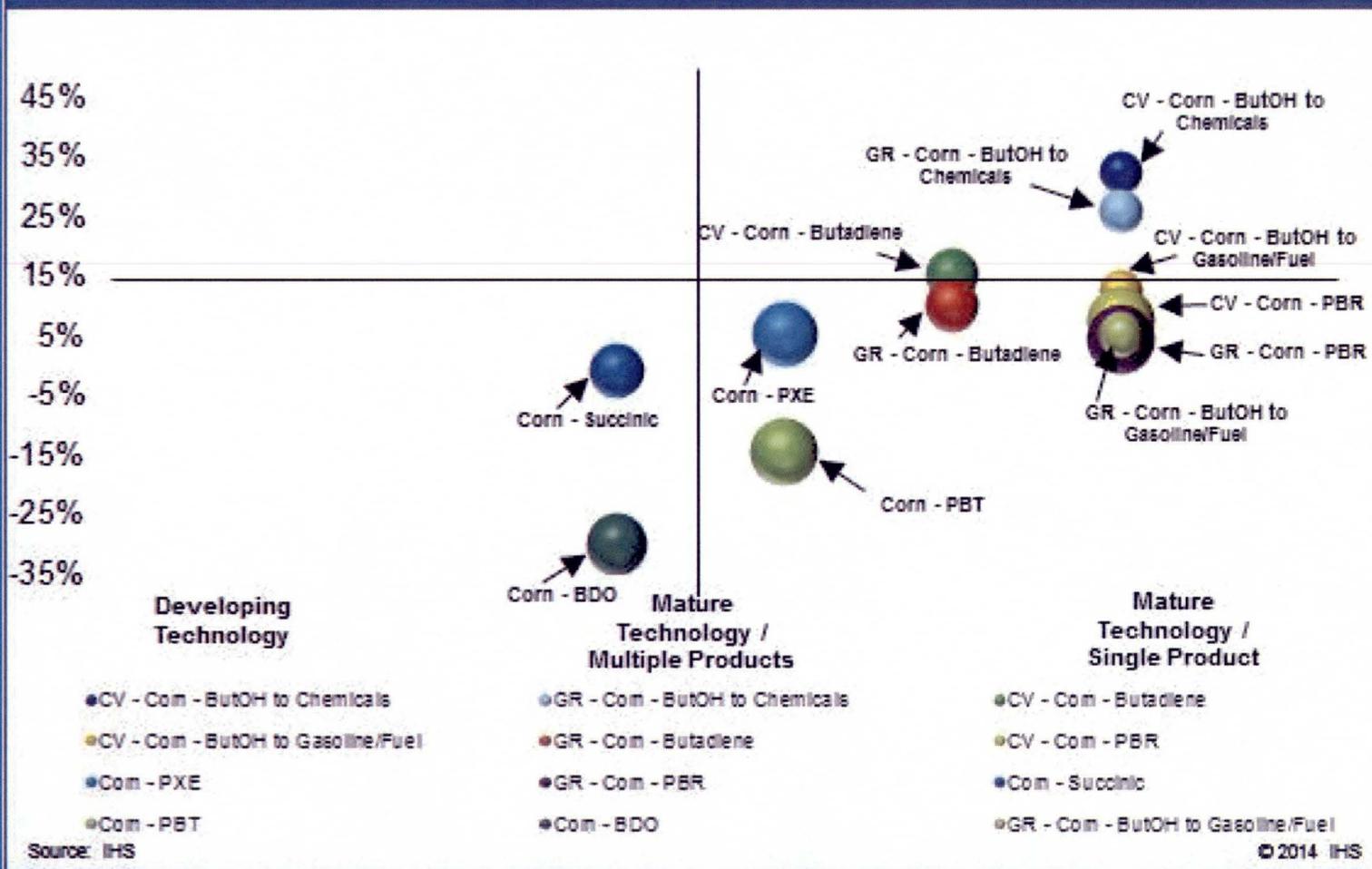


More than half of the consumption in US is within reach of a North Dakota Plant, while most production is centered in the U.S. Gulf Coast



Financial Model Results (Corn Based)

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



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**



State Incentives Summary

	OH	PA	WV	TX	LA
Job Creation Tax Credits	At least 10 jobs + \$660K over 3 years	At least 25 jobs or 20% increase over 3 years	At least 20 jobs at \$32K	At least 75 jobs in urban or at least 25 jobs in rural area	At least 50 jobs + \$500K
Low Interest Loans/Grants/Bonds	Business incentive grants; low interest loans	Low Cost Capital through programs such as "PA First", Pennsylvania Economic Development Authority		Cash grants for "deal closing" Range from \$225K to \$40 million; competitive, variable interest rates	Performance based grants; Eligible expenses are infrastructure and site improvements for new projects
Tax Exemption	Special districts, such as enterprise and empowerment zones, reinvestment areas, and brownfields	Special districts: Keystone Opportunity Zone/Keystone Opportunity Expansion Zone, Keystone Special Development Zones, Industrial Sites Reuse, Tax Increment Financing	Various tax credits; general, corporate HQ, high tech, job creation General tax credit up to 35% on initial investment; taken against corporate net income tax 95% abatement of local property tax for 10 years	An appraised limit on the value of taxable real property for 8 years Tax refunds; investment greater than \$250 mill and up to 500 jobs Manufacturing expenses	100% abatement of local property tax for 10 years 1-time credit of \$2,500 per new job
Payroll Incentive	Workforce grants and in-kind services				Rebates to 15% of new annual gross payroll up to 10 years
R&D Incentives	Tax credit			Tax exemption for R&D property	up to 40% tax credit on expenditures
Skills Development		Job training tax credit		Training funds	Customized job training, at least 15 jobs



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

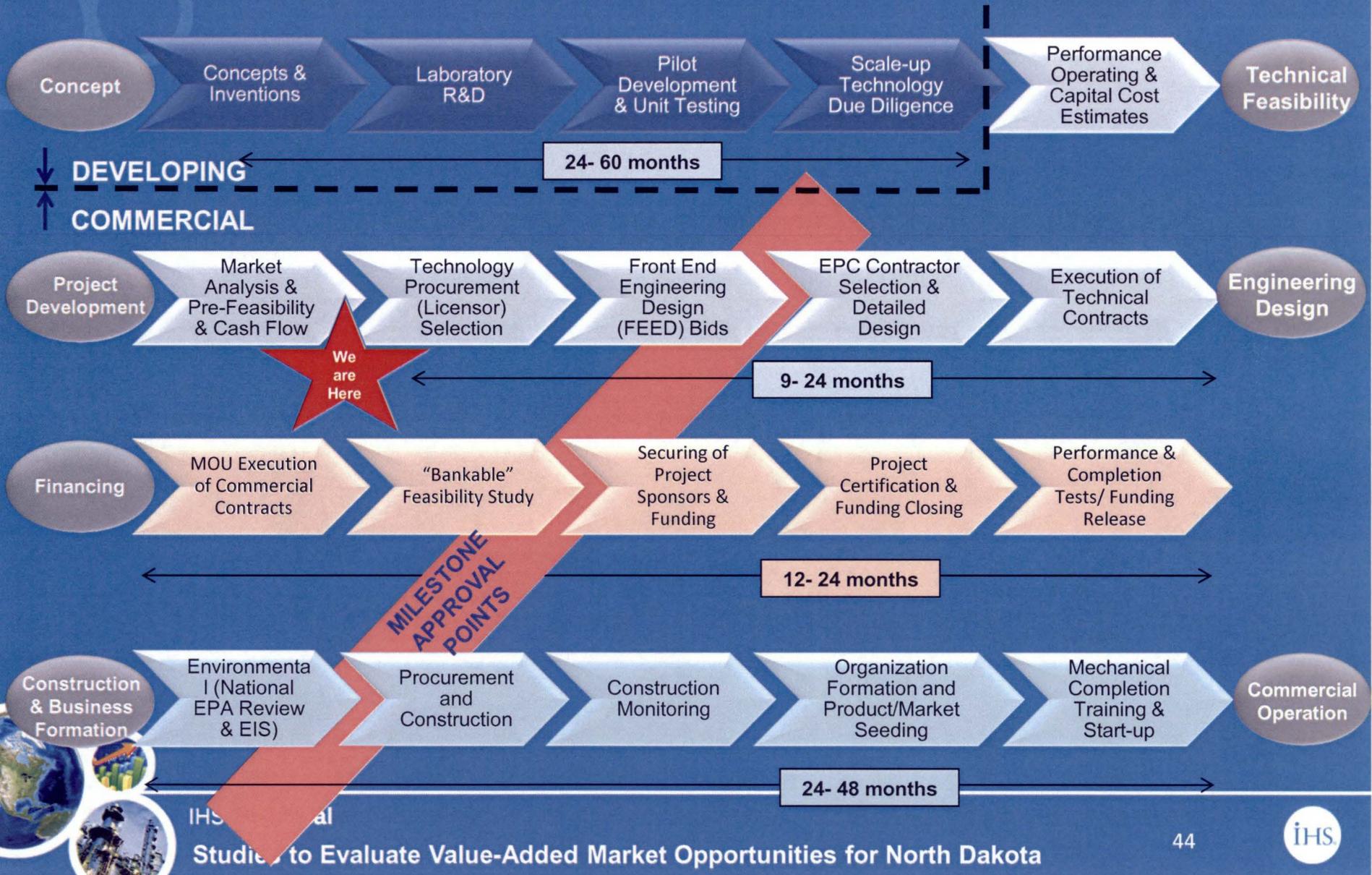


Post-Study Steps

- **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**



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



Appendix 1: 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

KMT HDPE Used,
2013

Locations

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

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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)

KMT PBR and SBR
Used, 2013

US Tire Producers

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

IHS Chemical

Studies to Evaluate Value-Added Market Opportunities for North Dakota

Appendix 2: Bio-Chemical Landscape



There is a Wide Range of Industrial Bio-Chemical Development

Here is a small sample.....

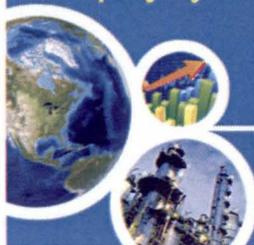


PMMA: polymethylmethacrylate
 POM: polyoxymethylene or polyacetal resin
 PGA: polyglycolic acid
 PE: polyethylene
 EPDM: ethylene propylene diene monomer
 PS: polystyrene

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



Appendix 3: 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



Studies to Evaluate Value-Added Market Opportunities for North Dakota

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

Don Bari, Vice President, Consulting

Edward Glatzer, Managing Director, Consulting

Energy Development & Transmission Commission

August 14, 2014

North Dakota



Bismarck, North Dakota

IHS Chemical

Studies to Evaluate Value-Added Market Opportunities for North Dakota