METHANOL MARKET DISTRIBUTION INFRASTRUCTURE IN THE UNITED STATES

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INTRODUCTION

The Methanol Institute has engaged DeWitt & Company, Inc. to provide a general overview of the US methanol market distribution infrastructure. The report includes both the written text and supplemental PowerPoint slides illustrating the various aspects of US methanol market infrastructure.

The text portion of the report includes the following sections:

? INTRODUCTION AND BACKGROUND
? METHANOL SUPPLY/DEMAND HISTORY
? MAJOR US IMPORT & DISTRIBUTION HUBS
? GENERAL OVERVIEW OF PETROCHEMICAL BULK TANK STORAGE
? GENERAL OVERVIEW OF COMMON TRANSPORTATION METHODS
? MISCELLANEOUS
  – US IMPORT DUTY AND RATES
  – METHANOL CONVERSIONS
  – INDUSTRY TERMS AND ABBREVIATIONS

BACKGROUND

Following many years of studying the global methanol markets, DeWitt & Company has prepared a critical and detailed review of the US methanol distribution infrastructure. The primary rationale for undertaking this study was largely driven by emerging fuel cell technologies, which are likely to create new markets for methanol as a hydrogen carrier fuel. This study examines the real world of supply, demand and logistics to create a better understanding of the existing methanol distribution network in the United States – and how this already vast network can be adapted to serve markets for fuel cell vehicles, as well as stationary and portable fuel cells.

Methanol is a widely used commodity chemical, which is readily available throughout the United States. Beyond the primary terminalling/distribution nodes, virtually every major metropolitan area has chemical storage facilities that are suitable for methanol. Methanol can be moved from the production plant or import terminal in bulk quantities anywhere in the country.

Methanol is produced in a number of different ways, but the primary route to production is through the synthesis of natural gas. Typically, natural gas is the major cost of production and as such, cheap natural gas is one sure way to develop a competitive advantage for the production of methanol.

I. SUPPLY /DEMAND HISTORY

US Methanol Supply Overview – North America is the largest methanol consuming region in the world. United States 2001 estimated consumption exceeded 2.6 billion gallons (8 million metric tons). Until the late 1990’s, the US had 18 methanol plants, with production capability exceeding 2 billion gallons (7 million metric tons).

The following table details US methanol production facilities:

Methanol Plants in the United States					
Company	Location	PADD	MMGPA	KTPA	Built
Motiva	Delaware City, DE -- closed	1	100	300	1978
Air Products	Pace, FL	1	60	180	1969
Tennessee Eastman	Kingsport, TN	2	65	195	1987
Terra*	Woodward, OK	2	40	120	1994
Ashland	Plaquemine, LA -- closed	3	160	460	1983
Borden	Geismar, LA -- closed	3	330	990	1965
BP/Sterling	Texas City, TX -- closed	3	150	450	1975
Enron	Pasadena, TX -- closed	3	125	375	1970
Lyondell*	Channelview, TX	3	260	780	1983
Fortier	Fortier, LA --- closed	3	190	570	1994
Georgia Gulf	Plaquemine, LA -- closed	3	160	460	1981
Celanese	Bishop, TX	3	167	501	1[illegible]
Celanese/Valero	Clear Lake, TX	3	200	600	1[illegible]
Liquid Carbonics	Geismar, LA	3	30	90	1979
Millennium	Deer Park, TX	3	200	600	1968
Terra/BMC*	Beaumont, TX	3	283	849	1977
Coastal	Cheyenne, WY	4	27	81	1989
Sand Creek	Commerce City, CO -- closed	4	33	99	1969
* = merchant	18 plants (10 now operating)		2586 (1332 operating)	7700 (3996 operating)	

The plants in the shaded areas are no longer operating. Most of these plants were shut down in the late 1990’s/early 2000’s for a variety of reasons - including economic, strategic and regional issues/disadvantages. During this period, several new world scale methanol production facilities were built in regions with relatively cheap natural gas feedstock. At the same time, US natural gas feedstock prices were climbing to historically high levels. As a result, some of the older vintage US methanol plants found it difficult to compete with these new plants that were much larger and more efficient.

Today, the United States produces approximately 3.5 - 4 million metric tons per year, varying by operating rates. Most of the producers identified as “*merchant” above sell their methanol into the open market, representing roughly 40 percent of US methanol production (1.5- 2 million metric tons). The other producers are primarily captive, using their methanol production internally as a feedstock for other products. US captive production totals approximately 2.25 million metric tons. The balance of methanol demand is covered in the large global merchant market through imports.

In 2001, the United States imported approximately 5.4 million tons of methanol, according to government data from the US Bureau of Census. The largest exporters to the United States are Trinidad, Chile, Venezuela, Canada and Equatorial Guinea. Each of these suppliers enjoys favorable trade status with the United States (under the Caribbean Basin Economic Recovery Act, General System of Preferences, the North American Free Trade Act, etc.), and most have been reliable suppliers of methanol to the US market for many years. The United States occasionally exports relatively small volumes of methanol to Mexico, the Caribbean and South America. The following table shows methanol import volumes into the United States from the major exporters, and their duty status.

2001 Methanol Imports to the United States from Major Suppliers		
Country	**US Imports 2001**	**Duty Status**
Chile	963,000 metric tons	GSP
Trinidad	1,649,000 metric tons	CBERA
Venezuela	832,000 metric tons	GSP
Equatorial Guinea	407,000 metric tons	GSP
Canada	361,000 metric tons	NAFTA

Major Methanol Derivatives in the US – Methanol is an important chemical building block used for many organic intermediates and downstream processes including esterification, ammoniation, methylation, and polymerization. The primary chemical intermediates produced from methanol include formaldehyde, acetic acid, methylamines, methyl methacrylate (MMA), Dimethyl Terephthalate (DMT), MTBE, and many other smaller applications. Formaldehyde and MTBE account for over 50 percent of methanol demand in the US, and acetic acid accounts for about 11 percent of US methanol demand. Some of the final products that are made from methanol's intermediates include: adhesives for wood products such as plywood, particle board and wafer board; paints and coatings; inks and dyes; plexiglass; polyester fibers, films and bottles; and high-octane gasoline additives.

On a global basis, **formaldehyde** has been and continues to be the largest methanol derivative. Formaldehyde is a very regional business due to the shipping costs involved in moving a product that can contain as much as 50-70% water. Formaldehyde facilities are usually built close to the ureaformaldehyde/phenol-formaldehyde resin manufacturing facilities that make up about 50% of formaldehyde demand into the wood products industry, including plywood, particle board and wafer board. These formaldehyde facilities are usually built in the heavily wooded areas of North America in the Pacific Northwest, the Southeast US and Eastern Canada. Most US Gulf Coast formaldehyde facilities are geared toward the chemical derivative uses of formaldehyde, including moulding compounds, paints and synthetic lubricants.

Methyl tertiary butyl ether (MTBE) – In the 1990's, MTBE production capacity grew in the United States from about 4,000 barrels per day to more than 250,000 bpd. Capacity outside the US has grown about as rapidly, amounting to 328,000 bpd in the late 1990's. Markets for MTBE in the US have been largely driven by the legislative mandates of the federal Clean Air Act Amendments of 1990, (CAA), which required the use of oxygenated gasoline in areas of the country with the worst air quality. It is now expected that US demand will be reduced in the middle of the decade due to resistance to the use of MTBE resulting from concerns of groundwater contamination from leaking underground storage tanks. Outside of the US, some MTBE is required for clean air purposes in parts of Europe and Asia, but most of it finds its way into voluntary markets as a gasoline extender and octane-enhancer. It is produced by the etherification reaction of isobutylene and methanol, and as such, it is a major market for methanol. It takes about one gallon of methanol to produce three gallons of MTBE.

Acetic acid – Acetyl products find their way into a number of industrial sectors. Acetic acid is the core of these products generating annual revenues in excess of \$2 ½ billion dollars. Perhaps surprisingly there are only a handful of key players, whose success has largely been dependent on their ability to integrate themselves into the downstream derivatives. The largest derivative is vinyl acetate monomer, which accounts for approximately 40% of the global demand. Other key derivatives are acetic anhydride, esters and terephthalic acid. Over the past 10 years, two players – Celanese Chemicals and BP Amoco – have dominated the business. Recent technological advancements by both companies will help them retain their leadership position during the next decade. In 1999, acetic acid demand was over 6 million metric tons and future growth is expected to continue at a healthy 4% per annum. Most of this growth is expected to be in the Asian / Middle Eastern / African regions.

Other – Methanol is also used as a solvent in a number of industrial applications including chemical, pharmaceutical, paint and varnish, natural gas, petroleum, automotive and aircraft. Methanol is commonly used in chemical and synthetic lubricants, gasoline line de-icers, and enjoys widespread use in windshield washer fluid. The windshield washer fluid and de-icer markets for methanol are quite robust, particularly in the Midwest and Northeastern United States – where wet and freezing weather are most pronounced. There is a broad range of distributors of these products throughout the United States, and it is a well-established/long-running market.

II. MAJOR DISTRIBUTION HUBS

The largest US methanol plants are concentrated on the Texas Gulf Coast between Houston and Beaumont, and are in close proximity to a large percentage of the major methanol derivative plants. Some of the methanol plants in this region are connected by pipeline to major derivative plants – both merchant customers and intra-company transfers. Otherwise, US merchant methanol production is either loaded by barge, railcar or truck for delivery to customers in the Houston area and throughout the United States.

Methanol imports enter the United States at a number of regional ports, although almost 80 percent of the volume enters the Texas and Louisiana Gulf Coasts. While Methanol is consumed all across North America, the bulk of the consumption is on the US Gulf Coast between Texas and Louisiana. Imports into Louisiana can also easily be re-loaded onto smaller barges for easy movement up river into the Midwest region.

General distribution hub overview:

Houston Ship Channel – The Houston Ship Channel is the Texas Gulf Coast's central interchange point, accessing vessels, barges, railcars and trucks – allowing for transportation to virtually anywhere in the United States. It is recognized as a distribution hub for Houston's refineries and petrochemical facilities. Both private and public terminals in this region serve as the western Gulf Coast refining and petrochemical community's central interchange point. Dedicated methanol storage terminals – both public and private – are widespread throughout the area. These terminals combined are connected to every Gulf Coast refinery and petrochemical plant from Corpus Christi to Houston/Baytown. Two railroads serve Houston and provide service to all points in the United States. The railroads – Burlington Northern-Santa Fe and Union Pacific – are members of the Port Terminal Railroad Association, which provides switching service to all Turning Basin docks. More than 100 truck lines serve the Turning Basin, which is located just five miles from two major interstate highways that run north-south and east-west. Direct discharge and loading are possible at this terminal, using either rail cars or trucks.

Port of New Orleans – New Orleans is the Louisiana Gulf Coast's central interchange point, accessing vessels, barges, railcars and trucks. Like Houston, delivery options throughout the United States are virtually unlimited. It is a major railroad interchange location between CSX (rail East of Miss River), Illinois Central, and Canadian National & Western Rail carriers (BNSF, Union Pacific). A few miles upriver from New Orleans, there is a major dedicated methanol terminal at St. Rose, Louisiana. This terminal serves the New Orleans/Baton Rouge corridor's producers of petroleum, chemicals and other products. It has evolved into another major US Gulf Coast methanol import and terminalling/distribution center for Louisiana, the Southeastern United States, up River/Chicago, and the Midwest. Eleven major storage tanks (100,000+ barrels each) have been in place since early-to-mid 2000, and an additional five tanks were built during the second half of 2001. This significant new US methanol distribution center has evolved as a direct result of the recent economic shutdowns of high-cost domestic methanol production in Louisiana. The St. Rose facilities have access to every major railroad in the United States – which makes it an attractive location for international methanol suppliers/ importers. Sunshine, Louisiana also has a significant public terminal facility for US methanol importers. The facility is located within the Geismar Industrial Complex, ten miles south of Baton Rouge, on the Mississippi River, convenient to methanol customers in the region. The deepwater terminal at Sunshine is convenient for barge river movements to the Midwest region.

Port of Wilmington, North Carolina – The third largest US methanol import and distribution hub is located in Wilmington. It is recognized as the primary distribution hub for methanol consumers and distributors throughout the Southeastern United States, with several dedicated methanol terminals in service. The port's connecting rail line is owned and operated by North Carolina Ports Railroad Commission, with interchanging cars between the port and CSX system. There is inland rail service by CSX Intermodal and Norfolk Southern Railroad. Charleston, South Carolina is a slightly smaller methanol import hub, providing additional support to the large methanol network in the Southeastern United States – including the heavy concentration of formaldehyde facilities in the region.

Port of New York – After Wilmington, metropolitan New York/New Jersey is the next largest distribution/import hub for methanol. A vast array of transportation and storage/terminal services are available – convenient to the vast local customer base and for methanol customers and distributors throughout the Northeast and beyond. The major servicing railroads include CSX, Norfolk, and Southern.

US West Coast Ports – Methanol is imported into the West Coast primarily into Seattle, San Francisco and Los Angeles, providing a comprehensive distribution network throughout the Western United States. There are convenient rail connections with BNSF and Union Pacific, as well as truck movements throughout the region. The Pacific Northwest is a large consumer of methanol for formaldehyde. Methanol has been used in California by refiners for MTBE production for years.

Midwest – There is a robust distribution market for methanol throughout the Midwest. The more important inland distribution centers include Chicago, St. Louis, Cincinnati, and Pittsburgh. Dedicated methanol storage facilities, as well as a comprehensive railcar and highway network for trucks allow for active methanol movement throughout the Mid-Continent.

III. GENERAL TRANSPORTATION OVERVIEW

As new merchant methanol production came on-stream in the 1980's and 1990's deep-sea movements of methanol increased dramatically. As a result, dedicated methanol tankers became common. These tankers range in size, from about 15,000 mt for the smaller ships, to around 40,000 mt in the mid-size range, to the enormous 96,000 metric ton DWT vessel that was built for Methanex last year.

Once ocean tankers have discharged methanol into a bulk terminal facility or into an end user's own storage facility, there are several transportation options, depending on volume requirements. Typical inland movements involve tanker trucks, railcars, or barges. The US has limitless transportation options for reaching remote inland locations that are not accessible by deep-sea vessel or barge. Railway transportation is the most economic option (when there are no waterborne shipping options for barges) for distances over 250 miles. Rail freight costs between the US Gulf Coast and upper Midwest/Southern Canada generally vary between 11-15 cents per gallon.

Rail cars that carry quantities of methanol from a tank or plant site are typically 100 tons (a little over 30,000 gallons or almost 800 barrels). Chemicals are the second-highest volume of rail freight in the United States after coal. US railroads provide about 40 percent of the US's inter-city freight transportation. The US railroad system is extremely comprehensive, and methanol shipments can be made to virtually every major market in the United States and Canada.

Barge movements of methanol are seen between the Texas and Louisiana Gulf Coasts, as well as "up River" movements from terminals near New Orleans to discharge points throughout the Midwest. Typical methanol barges are 10,000 barrels (1255 mt or 417,915 gallons). Barges, the largest inland transportation method, deliver methanol to some of the larger inland customers and also into inland terminal facilities throughout the Midwest for re-distribution throughout the country by railcar or tanker truck, depending on volume and location.

Common Methanol Transportation Methods

	Gallons	Metric tons	Barrels
Barge	417,915	1,255	10,000
Railcar	30,000	100	800
Tanker Truck	8,000	24	191

Of approximately 8 million metric tons per year US methanol demand, about 6.5 million metric tons per year is covered in the merchant market through contracts or spot sales. This means that every month about 550,000 metric tons (183 million gallons) is transferred between sellers and buyers across the United States.

IV. PETROCHEMICAL BULK TANK STORAGE

Methanol can be stored in mild steel tanks, which are commonly used throughout the United States. Dedicated methanol storage tanks are already in service throughout the United States, and most major ports and terminal locations have ample room for expansion of existing facilities. The for-hire storage of bulk petrochemicals is only about 40 years old and is a function of transportation as a step in the delivery cycle. Some primary functions of petrochemical bulk storage include:

? **Transshipment –** As a gathering point to facilitate large inbound or outbound movements that might result in lower freight rates for volume. The modes of in-or-out transportation can be by water, road, or rail.

? **Operational –** To accumulate product as it is being produced. To take advantage of higher production rates that might not keep in line with consumption or outbound shipments.

? **Speculative –** To accumulate product in an upwardly mobile market and to take advantage of higher prices at a later date.

? **Distribution –** To accommodate and facilitate shipments and deliveries from inland terminals to lower volume local customers.

The two basic types of petrochemical storage are in-house (private) and public. Some companies not only have their own captive storage but also need to lease additional storage from public tank terminalling companies. Tanks for bulk petrochemical storage come in a variety of sizes. They can be custom built or converted. Mild steel is the recommended construction material for methanol storage tanks.

Public petrochemical tank storage companies can provide varied services for a customer. Besides the physical storage, these include inventory control, customs interface, and documentation such as the preparation of bills of lading. Petrochemical storage companies are service oriented and, for a fee, can perform many tasks for a customer. The majority of the activities of a tank terminal are related to the loading and unloading of ships. Multi-cargo handling and simultaneous loading and unloading at one berth became common practice to reduce harbor time and shifting expenses.

Although the main activities of a tank storage company are related to tank vessel/barge and shore tanks, additional product handling is common for connection to rail tank cars, and road tank trucks. Other services one can expect are preparation of customers' invoices, bills of lading and certificates of origin, and arranging for onward transport and insurance.

Storage costs are negotiable and vary depending on the product, tank size, special equipment required, mode of in and out bound shipments, contract terms, etc. In a broad sense, a public terminal company would charge a base rate per ton, per month for methanol stored in a 12,600 metric ton (100,000 barrel) tank on a year's contract. This base charge would include four tank capacity throughputs (50,400 mt/400,000 bbls) per year, and some extra incidental costs such as loading tank trucks and cars. Depending on customer/contract status, these terms are negotiable, particularly if more frequent throughputs are required. Four tank capacity throughputs per years (about a turn per quarter) are fairly standard. Storage costs per ton can be reduced significantly by increasing the number of throughputs per year.

Intermediate tank storage can be very instrumental in creating market stability. For example, the Houston and New Orleans methanol market is subject to wide variations created by the intermittent arrival of ships carrying methanol from deep-sea sources. It is oftentimes a feast or famine situation. This is a relatively new development in the US Gulf Coast market (due to the shut down of several merchant methanol facilities in Texas and Louisiana since the late 1990's).

V. MISCELLANEOUS

US IMPORT DUTY RATES – The duty rate for importing methanol into the United States is based on three classifications:

1. Methanol imported for use in producing synthetic natural gas (SNG) or for direct use as a fuel.

    ? For this classification there are no duties accessed for imports from any country except Afghanistan, Cuba, Laos, North Korea and Vietnam where the duty rate is accessed at $0.048 per liter ($0.18 per gallon).

2. Methanol, other than imports for use in producing synthetic natural gas or for direct use as a fuel.

    ? For this classification the duty rate is 9.2 % of value for imports from all countries except as follows:

    ? No duty is accessed for goods originating from countries belonging to GSP (A*see exception note), NAFTA, CBERA, ATPA and Israel.

? A duty rate of 46% of value is accessed for goods originating from: Afghanistan, Cuba, Laos, North Korea and Vietnam.

3. Methanol produced from natural gas aboard a vessel on the high seas or in foreign waters.

? For this classification there are no duties accessed for imports from any country except Afghanistan, Cuba, Laos, North Korea and Vietnam. The duty rate for these five countries is 46% of value.

The following chart, taken from the Harmonized Tariff Schedule of the United States 2001, gives a quick overview.

U.S. DUTY ON METHANOL IMPORTS

As taken from the Harmonized Tariff Schedule of the United States 2001

Heading	**Article Description**	**Unit Of Quantity**	**Rates of Duty**		
			1		**2**
			General	**Special**	
2905.11.10	Methanol imported only for use in producing synthetic natural gas (SNG) or for direct use as a fuel	liters	Free		$0.048 per liter
2905.11.20	Methanol, other than above	liters	9.2%	Free (A*,CA,E,IL,J,MX)	46%
9817.29.02	Methanol produced from natural gas aboard a vessel on the high seas or in foreign waters		Free		46%

METHANOL CONVERSION FACTORS & RATIOS

The conversion factors listed below are intended as guidelines only, as different equipment and processes can result in minor variances.

One metric ton (2,204.62 lbs) = 333 U.S. gallons of methanol

	LB/GAL	LB/BBL	BBL/MT
Methanol Conversions	6.63	278.50	7.97

Unit of Methanol Consumed	Per Unit of Product
Acetic Acid	0.55
Formaldehyde (37%)	0.45
MTBE	0.36
Methyl Methacrylate	0.39
Methylamines	1.45

The production of methanol from natural gas via a low pressure process consumes approximately 100,000-110,000 BTU's per US gallon or 33.3-36.6 million BTU's per metric ton.

COMMON METHANOL & INDUSTRY TERMS, ABBREVIATIONS

bbl	barrel (42 US gallons)
bcf	billions of cubic feet
bpd	Barrels per day
gal	gallon
DWT	deadweight
kg	kilogram
kt	kiloton
ktpa	Kilotons per year
lb	pound
ltr	liter
mcf	millions of cubic feet
Merchant plants	Production from these facilities is sold under contract or on the spot market to consumers, distributors, traders, or other producers.
mmbtu	million british thermal units
mmgpa	Million gallons per year
mt	metric ton
mtpa	Metric tons per year
PADD	Petroleum Administration for Defense Districts
PADD 1	East Coast
PADD 2	Midwest
PADD 3	Gulf Coast
PADD 4	Rocky Mountain
PADD 5	West Coast