

## Smart Transportation Exports – Top Market Opportunities White Paper Report May 24, 2016

This White Paper is presented by the REEEAC Smart Transportation (ST) Subcommittee to Secretary Penny Pritzker to demonstrate the top market opportunities in the Smart Transportation sector.

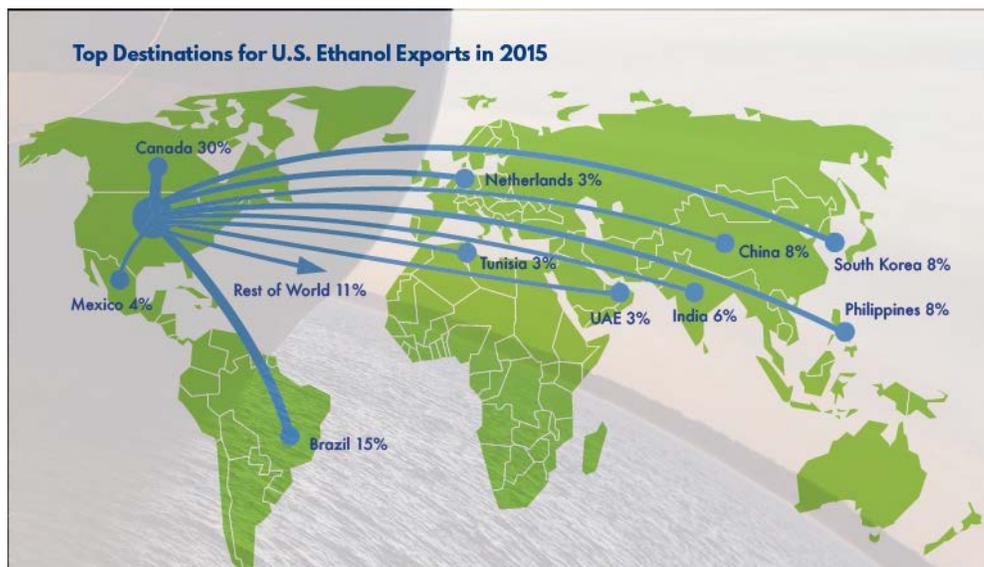
With the recent signing of COP21, carbon reduction is the forefront of efforts worldwide. Biofuels and electric vehicles can play a key role in reducing emissions and providing for a more sustainable future. This White Paper identifies key markets and opportunities that exist globally, as well as current efforts underway to develop new markets for US technologies and products. Four near-term markets have been identified: corn and cellulosic ethanol, renewable jet fuel for aviation, U.S. military fuels needs, and electric cars.

Recommendations for training for DOC staff and others to assist in facilitating the promotion of Smart Transportation exports will also be presented.

### 1. Corn and Cellulosic Ethanol

In 2014, the U.S. produced more than 54 billion liters of ethanol (14.3 billion U.S. gallons). U.S. domestic demand has resulted in a current average blend rate of 10 percent (E10). In 2014, U.S. ethanol was exported to more than 60 countries around the world for both fuel and other industrial uses. In 2014, the U.S. exported 3.1 billion liters (825 million U.S. gallons) of fuel ethanol and 11.3 million metric tons of DDGS. Total year-to-date U.S. ethanol exports stood at 753.9 mg at the end of November, which implies annualized exports of 822 mg—similar to 2014 volumes.

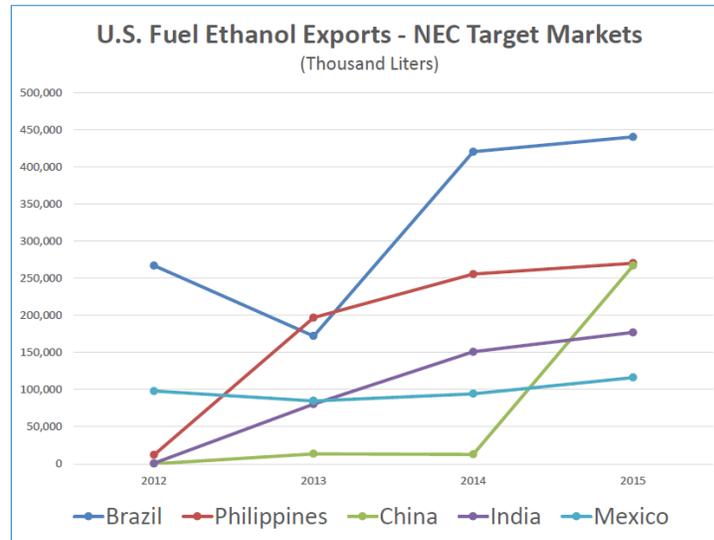
The two largest export markets for U.S. ethanol are Canada and Brazil. The top countries for growing ethanol exports include China, India, Mexico, Peru, and Philippines. Other developing markets are Japan, South Korea, United Arab Emirates, and Oman.



## ***Ethanol Market Promotion – New Orleans, LA***

The U.S. Commercial Service, in conjunction with the USDA in India, recruited potential ethanol purchasers from the top five countries (as strategically selected based on the 2015 Renewable Fuels Top Markets Report – Brazil, Philippines, China, India, and Mexico) to attend the NEC International Buyers Program, which was held in conjunction with the National Ethanol Conference in New Orleans, LA, February 15-17, 2016.

### ***Export Trends, 2012-2015***



Officials from SAGARPA and PEMEX also joined the Mexico delegation. (Since PEMEX is not buying directly, they did not have B2B meetings).

A recent successful outcome of the B2B meetings is that one of the US companies who participated has already reported a major shipment to India as a result. Demand in India is being driven by their blending policy, which in turn is putting pressure on India's domestic ethanol producers, so U.S. ethanol is actually being used for industrial purposes while domestic ethanol is shifted to the fuel market.

## ***APEC - Expert Group on New and Renewable Energy Technologies - Taiwan***

On April 12-13, a two-day workshop entitled "Ethanol Trade Development as Part of APEC's Renewable Fuel Strategy" was held under the umbrella of the Expert Group on New and Renewable Energy Technologies (EWG 12 2015A) was held in Taichung City, Chinese Taipei, funded in part through an APEC grant received by USDA's Foreign Agricultural Service.

The workshop brought together public and private sector experts from 14 member economies, as well as representatives of leading manufacturers and international organizations, to determine what role ethanol can play in meeting APEC's aspirational goal of doubling the share of renewables in the APEC energy mix by 2030.

The workshop participants agreed to the following:

1. Ethanol is a clean energy, renewable fuel, that can contribute to meeting APEC's goal of doubling renewables by 2030
2. The use of ethanol in transport fuel has several positive benefits, in addition to being renewable, including:
  - improves air quality,
  - reduces greenhouse gas emissions,
  - enhances the quality of petroleum-based fuels,
  - contributes to rural economic development
  - increases energy security through diversity of supply

Based on best practices of the workshop participants, governments can do the following in order to increase ethanol's share of the energy mix:

1. Provide a strong regulatory policy framework (inc, firm blending mandates) that gives investors the confidence to dedicate resources toward increased production and use;
2. Educate consumers in the benefits of higher ethanol blends and counteract negative misperceptions.
3. Implement trade friendly policies that provide investors with the necessary stability and availability of supply.
4. Implement policies that support the appropriate fleet of vehicles
5. Encourage and support industry innovation

In accordance with the *2015 Energy Ministerial Cebu Declaration* encouraging member economies to “cooperate on best practices;” “exchange information;” and “work toward achieving greater energy security, reduce carbon emissions, and promote trade and investment” the workshop participants propose the following next steps:

Under the leadership of the United States, with the contribution of interested member economies, the Expert Group on New and Renewable Energy Technologies will develop a roadmap recommending specific policies that detail how member economies can incentivize greater production, consumption and trade of ethanol, toward the goal of doubling the share of renewables by 2030.

The goal of this proposal is to present this roadmap to APEC Senior Officials at SOM 3 in Peru in 2016 or other relevant APEC meeting.

### ***International Cellulosic Ethanol and Advanced Biofuels Technology Exports***

Recent announcements for technology transfer of cellulosic ethanol and other advanced biofuels technology exports include Lanzatech (China and Belgium), DuPont (China), and Amyris (Brazil and South Korea).

## **2. U.S. Department of Navy International Engagements for the Use of Alternative Fuels**

The mission of the Navy and Marine Corps is to provide the global presence necessary to ensure stability, deter potential adversaries and present options in times of crisis. Power is critical to the DON's ability to provide that presence. The Department of the Navy is leveraging its use of energy to make us better warfighters. They are deploying next-generation capabilities that boost combat effectiveness, increase operational flexibility, and better protect our Sailors and Marines.

In order for the Navy and Marine Corps to conduct their mission using alternative fuel blends, they need to have full acceptance with their international allies and partner nation Navies. Interoperability is key to conducting operations at sea. When ships need to be refueled, various options are sometimes available with different nation's oilers. If the only option is to use a U.S. Navy oiler, and they only have alternative fuel blends, then all of the ships involved in that operation will need to be certified to use alternative fuel blends.

To that end, the Navy and Marine Corps have been working with their international allies to help them get certified to use alternative fuel blends. In 2012, when they conducted our Great Green Fleet demonstration during the Rim of the Pacific (RIMPAC) exercise, the Royal Australian Navy was the only ally that used our 50/50 alternative jet fuel in one of their helicopters.

The Navy and Marine Corps are now purchasing alternative fuel blends as a part of their normal bulk fuel purchases that are drop in replacements, and all of the fuel – traditional and alternative – goes into the same fuel tanks. They are not using separate storage tanks for the alternative fuel blends. In 2016, the year of the Great Green Fleet, the U.S. Navy will be supplying all of the fuel for the RIMPAC exercise. Therefore, all of the 14 nations that will be bringing ships to the exercise will be getting an alternative fuel blend of our middle distillate diesel F-76.

In preparation for this exercise and for all of our future operations around the world, the Navy and Marine Corps have been meeting with Naval Attaches at the foreign embassies in Washington, DC, and foreign navy operational and fuel personnel when visiting other countries, to tell them about their alternative fuel program. In the table below is a listing of the major countries they have engaged with, along with the date that they plan to be certified, or have reached certification for both the F-76 diesel fuel for our ships and the JP-5 jet fuel.

The table below highlights where there are other potential markets for renewable diesel and renewable jet fuels. This list does not include all of the navies worldwide, but it does represent the major powers (with more tonnage of ships). The foreign navies are just the tip of the iceberg, because those nations will also want to move their commercial aviation towards drop-in replacement fuels, too. However, they will want the renewable fuels to be cost competitive.

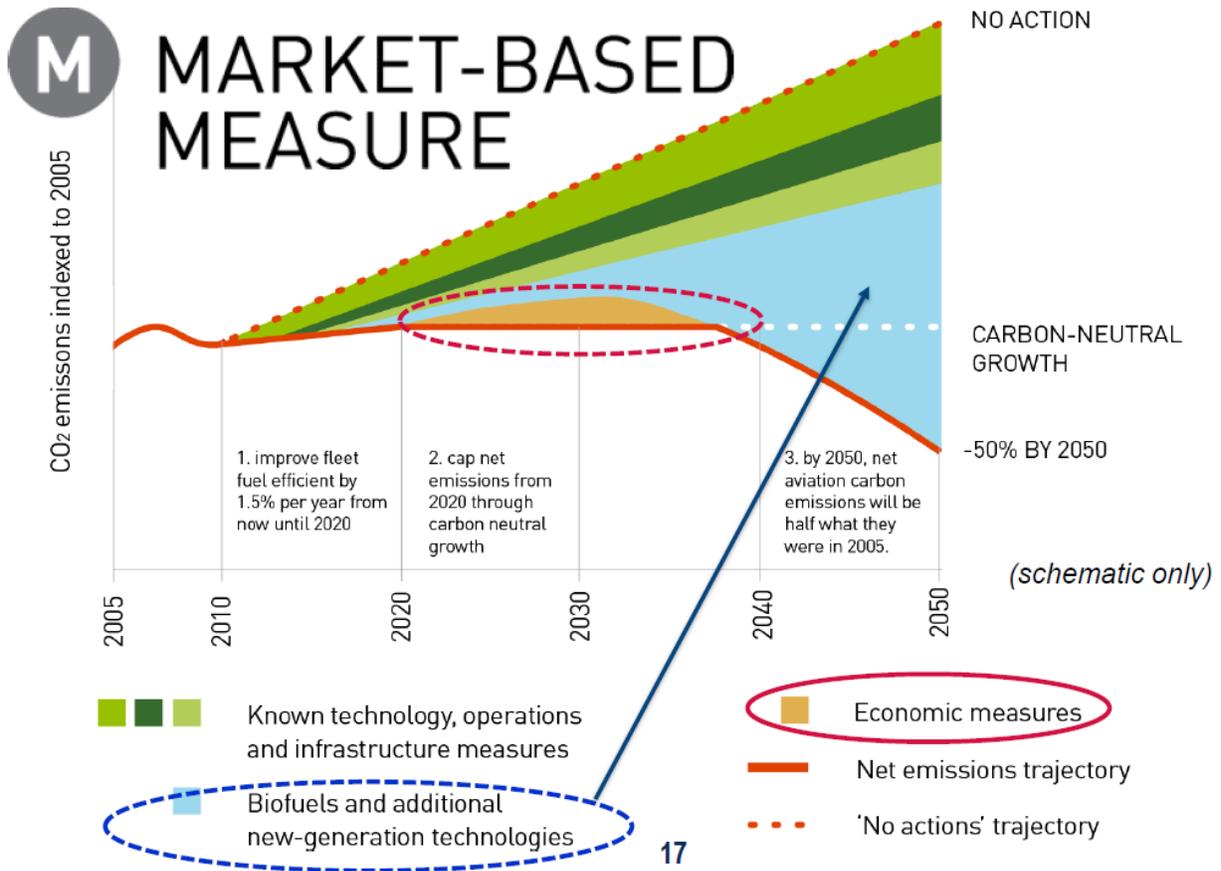
***Potential Military Markets for Renewable Diesel and Jet Fuels***

<b>Country</b>	<b>Tonnage</b>	<b>Plan to be F-76 Certified</b>	<b>Plan to be JP-5 Certified</b>
<b>Japan</b>	340820	4/6/2016	10/31/2016
<b>United Kingdom</b>	330150	1/1/2015	12/1/2015
<b>France</b>	320135	12/1/2015	12/1/2015
<b>India</b>	282881	9/30/2016	
<b>South Korea</b>	177256	4/6/2016	
<b>Italy</b>	173034	12/1/2015	12/31/2016
<b>Indonesia</b>	125774	9/30/2016	
<b>Australia</b>	98426	12/1/2015	12/1/2015
<b>Canada</b>	94000	4/6/2016	4/1/2015
<b>Chile</b>	72804	4/6/2016	
<b>Singapore</b>	72040	4/6/2016	
<b>Norway</b>	37172	4/15/2015	
<b>New Zealand</b>	29071	11/1/2015	11/1/2015
<b>Mexico</b>	N/A	9/30/2016	
<b>Colombia</b>	N/A		
<b>Malaysia</b>	N/A		
<b>Philippines</b>	N/A		
<b>Brazil</b>	150033		
<b>Turkey</b>	144748		
<b>Germany</b>	87563	12/31/2016	
<b>Peru</b>	80162		
<b>Denmark</b>	51235		
<b>Netherlands</b>	79076	12/31/2016	
<b>Vietnam</b>	43562		

**3. Renewable Jet Fuel**

Global air traffic is projected to grow substantially in the next decades (between 3-4% per annum) but CO2 emissions shall remain constant from 2020 onward (“carbon-neutral growth” goal by ICAO). Carbon-neutral growth not achievable with aircraft and infrastructure efficiency improvements alone. The table below shows the market-based measures proposed to meet aviation emissions reductions targets.

*Market-based Measures Proposed to meet Aviation Emissions Reductions Targets*



*To accomplish these goals at the highest modeled GHG emissions reductions will require:*

- Optimistic assumptions on increases in agricultural productivity, land availability, sustainable residue removal rates, conversion efficiency improvements, reductions in GHG emissions of utilities
- Construction of >200 large biorefineries per year, every year between 2020 and 2050, at an annual capital investment of \$20-\$90 bn.
- Strong market or policy emphasis on alcohol-to-jet fuel (AJF), which would entail large shares of the available bioenergy pool be devoted to producing AFJ.
- Emissions reduction on the order of 10-20% (production of approx. 3-6 Million barrels per day) in 2050 require annual investment every year out to 2050 similar to global annual investment in biorefineries in the years 2000-2010 (50-100 new large biorefineries per year).

#### **4. US Electric Vehicle Export Potential**

In 2015, global production of electric vehicles (EVs) was 3.23 MM units, or 3.7% of total worldwide vehicle production of 88.44 MM units. According to PwC Autofacts, by 2022 these figures are expected to grow to 8.09 million and 110.69 million units respectively, resulting in a projected EV market share of 7.3%.

The term electric vehicles refers to a number of different technologies. The largest segment is the traditional full hybrid (70.5% 2015 market share), such as the original Toyota Prius, which combines gas and electric motors, and charges its battery as it drives. The next largest segment is the rapidly growing plug in-hybrid (11.1% 2015 market share), such as the new models that Prius and many others now offer, which after charging, has a pure electric range good for local trips and commuting, and uses a gasoline engine for longer trips.

The next segment is battery powered pure electric car (10.2 % 2015 market share), such as the Nissan Leaf or Tesla line, which plugs in to recharge, and is the segment most subject to “range anxiety,” and would benefit most from further development of lithium ion batteries. The next segment is the mild hybrid (8.1% 2015 market share), which doesn’t plug in or run in full electric mode, but does use an electric drive system to increase fuel economy. Finally, there is the hydrogen fuel cell driven electric vehicle (0.1% 2015 market share), which would require a major buildout of refueling infrastructure and is not currently projected (at least by PwC) to command significant market share in the near future.

Among US makers, current production includes the Chevrolet Volt, Bolt and Spark; Buick e-assist models of the Regal and LaCrosse; Cadillac ELR; Ford Fusion, Focus and C-Max; Lincoln MKZ; and Tesla models S and X. These are all assembled in the US, except for the Chevy Spark, which is made in Korea. The US content of these cars ranges from approximately 35% for the Fusion and Spark, to 75% to the Tesla Model S.

Foreign EVs assembled in the US include the Nissan Leaf and Toyota Avalon and Camry hybrids, which all have approximately 40% US content. Interestingly, the German built Mercedes Benz B Class E Cell has approximately 30% US content, due to its drivetrain provided by Tesla, in which Daimler Benz has an equity investment. (US content figures from the Kogod Made in America Auto Index, published by American University’s Kogod School of Business.)

In 2015, US manufacturers – Ford (66K), General Motors (23K) and Tesla (50K) – produced approximately 139,000 units, or 4.3% of the global EV market. The US manufacturers don’t release sales projections, but Ford and GM have primarily focused on the US domestic EV market thus far, with negligible exports. Only Tesla, in its 10Q report, has stated that expects almost half its long-term vehicle revenues from sales outside North America.

These numbers will increase dramatically however, as Tesla started accepting orders in early April for its new Model 3, which starts at \$35,000 and is due to start production in 2017. By the end of the month it had received 400,000 orders and deposits, according to Fortune magazine.

The world's top 10 manufacturers of lithium ion batteries for EV's, as of 2015, from the EvObsession.com website are: Panasonic, AESC, BYD, Mitsubishi/GS Yuasa, LG Chem, Samsung, Wanxiang, Beijing Pride Power, Tianneng and SB LiMotive. These companies are all Japanese, Chinese, or Korean, although four of them have US manufacturing operations, most prominently Panasonic's partnership with Tesla, and Wanxiang's acquisition of A123 out of bankruptcy.

The world's primary EV markets are the US, Western Europe, Japan and China. Realistically, with the exception of Tesla, US EVs and lithium ion batteries are both going to have to reach critical mass in the domestic market before they can reasonably expect success in the export markets, but with the growth expected in these sectors, they should receive continuing federal focus and support.

## **5. Conclusions and Recommendations**

There is a multi-billion dollar opportunity annually for product and technology exports from ethanol, military fuels, renewable jet fuel, and electric vehicles. The time is now for these U.S. products and services to be promoted internationally. There needs to be a strong investment climate and a strong regulatory climate developed in these countries to take advantage of this opportunity.

### ***Key Components and Steps toward Success***

1. The Department of Commerce/International Trade Administration industry analysts should act as a liaison to the U.S. Commercial Service Global Energy Team, and other relevant staff, to provide information and materials to assist in deploying new business leads for *Smart Transportation* products and services.
2. REEEAC Members and other industry partners will present at upcoming DOC Conferences and webinars to train DOC staff on opportunities in key export countries.
3. Develop a training module to disseminate information through a webinars or as a brochure.

### ***Interagency Partners***

Environmental Protection Agency  
Department of Agriculture  
Department of Energy  
Office of the U.S. Trade Representative  
Department of Transportation

### ***NGO Partners***

Sustainable Energy for All Sustainable Bioenergy Group  
U.S. Grains Council  
CAAFI