Future Fuel Trendlines:
Second Quarter 2017

Quarterly Report for Clients
April 2017
In addition to my consulting activities, I have developed a service called the Future Fuels Outlook that tracks, monitors and analyzes market and policy trends and their potential to fundamentally impact future vehicle and oil demand so that clients can develop strategies to support their businesses/business units.
Future Fuels Outlook Service

Focus on Future Fuels & Vehicles Trends, Especially Those “Unseen” Potential Game Changers

Idea is to look at these issues in a holistic, integrated way to draw out key trends and intelligence that are helpful in your work and business and allow you to assess strategic threats and opportunities.
<table>
<thead>
<tr>
<th>The Deep Dive</th>
<th>Quarterly Trends</th>
<th>Web Conferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Original, in-depth analysis delivered directly to you at least once a month on future fuels issues with unique market and policy insights you've come to expect from me as well as competitive intelligence drawing from my extensive global network.</td>
<td>• Delivered directly to you, a quarterly review of emerging trends in the marketplace presented by webinar with client Q&amp;A and a summary report to accompany the presentation and webinar.</td>
<td>• A panel of experts come together on a quarterly basis to talk about key topics in an open format with Q&amp;A from clients, who get access to the recording and any presentations given.</td>
</tr>
</tbody>
</table>
Recap: Issues I'm Following for Clients (1/2)

**Air Pollution**
- Significant air pollution studies that relate to transport.
- Social movements and advocacy on air pollution that could impact transport.

**Climate Change**
- What will a Trump Administration do on the Paris Agreement and climate change generally and how could that affect future fuels and vehicles?
- Other significant actions related to Paris Agreement implementation and climate change mitigation from transport, including the COP-23 meeting in Fiji later this year.

**Biofuels**
- Decreasing carbon intensities of 1G biofuels facilities and what it means for advanced biofuels.
- Any actions that Trump may take on the RFS program.
- The Winter Climate and Energy Package as it moves toward final approval in Europe.
Recap: Issues I’m Following for Clients (2/2)

**Dieselgate Fallout**

- Further fall out from Dieselgate and potential impacts to the European and other markets, including whether there are opportunities for gasoline and electric vehicles.
- Implementation of the RDE program in Europe (and the push to implement it elsewhere).
- Movements to ban diesel cars or the sale of diesel, which has been happening in a number of cities.

**Fuel Economy**

- Whether the Trump Administration will provide relief to the auto industry on the fuel economy standards or otherwise challenge them, and/or whether the auto industry will find a way to challenge the standards in court.

**ZEVs**

- ZEV policies, including incentives and mandates, sales and technological developments.
- Ride sharing, connectivity and autonomous driving developments, especially as they intersect with ZEVs.
- The Trump Administration response to ZEV developments and whether President Obama's electrification policy will be dismantled.
“The Headlines” in This Presentation

**Air Pollution**
- New studies linking health & environmental impacts of air pollution to transport
- Galvanizing cities, especially on diesel

**Climate Change**
- Only a few countries have submitted plans. Not impressive.
- Decarbonizing some sectors in transport sector difficult and hardly focused upon until now

**Biofuels**
- Icahn may not succeed on point of obligation issue
- Declining CI for ethanol a game changer for advanced biofuels and oxygenates
- The Commission's goal to provide certainty in biofuels policy will probably do the opposite

**Fuel Economy**
- Reopening the mid-term review may be great for ethanol
- Early guess: standards delayed until 2030

**ZEVs**
- Not much movement on ZEV policy globally (but the year is young)
- Federal tax credit expiration may hurt EV market outside of California (unless states step in)
AIR POLLUTION
Significant Air Pollution Study
92% Live in Areas Where PM Exceeds WHO Guidelines

Figure 1. Global ranking of risk factors for total deaths from all causes for all ages and sexes in 2015.

Source: State of Global Air, 2017
PM 5th Major Risk Factor for Total Deaths

Highest Concentrations in Africa & Middle East (Fugitive Dust)

Figure 2. Average annual population-weighted PM$_{2.5}$ concentrations in 2015.

Source: State of Global Air, 2017
Ozone Concentrations in 2015
Increase 7% from 1990-2015

Figure 5. Seasonal average population-weighted ozone concentrations in 2015.

Ozone (µg/m³)
- 25 to <42
- 42 to <54
- 54 to <65
- 65 to <76
- 76 to <117
- No data

Source: State of Global Air, February 2017
THE CONTINUING FALLOUT FROM DIESELGATE
ICCT to capture detailed information on pollutants from vehicle exhaust using remote-sensing equipment and portable emissions monitoring systems

Thought is that RDE when it takes effect in Europe will not be that effective

Another way to promote transparency to consumers and reduce pollution

Other cities will follow London & Paris

Meant to encourage the auto industry to comply with RDE rules early and close the loop between lab and real-world emissions
Barcelona will ban all cars older than 20 years old from 2019
A court has ordered Munich to develop plans by the end of this year for banning diesel-fuelled cars
Paris, Madrid, Athens and Mexico City announced plans in December 2016 to take diesel cars and vans off their roads by 2025
New Delhi banned all new large diesel cars and SUVs with engines of more than 2,000CC and is phasing out thousands of diesel taxis.
Oslo plans a “no car zone”
Zurich has capped the number of parking spaces in the city, only allows a certain number of cars into the city at any one time, and is building more car-free areas, plazas, tram lines and pedestrianised streets
CLIMATE CHANGE/
PARIS AGREEMENT
Paris Agreement Implementation (or Lack)

Will the U.S. Stay or Go? What Will Other Countries Do?

- No one knows what the Administration is going to do about the Paris Agreement (including the principals)
- **My View**: the U.S. will stay in the Agreement but won't be obligated to do much to implement it and with CO2 emissions declining, they won't need to
- The “Deep Decarbonization” plan submitted to the UNFCC by the Obama Administration is all but dead
  - That plan relied heavily on transport, employing electrification, low carbon fuels and steeper fuel economy measures to combat climate change
- Beyond the countries I mentioned in January, no other country has submitted their decarbonization plan (NDCs)
- Ending fossil fuel subsidies and putting into place a global carbon tax scheme of some kind is off the table
- The carbon tax plan offered by James Baker, et al. is clever but a non-starter for Democrats and Republicans
- China will try to assume a stronger leadership role and is happy to put off the discussion on a global carbon tax
- What can't be done at the national level might end up galvanizing state/provinces and cities
Similar to IRENA/IEA, the PPMC envisions fuel economy, ZEVs and biofuels for shipping and aviation to decarbonize transport.
Motorized mobility in cities is set to double between 2015 and 2050, rising 41% to 2030 and 94% by 2050 in the Outlook’s baseline scenario. The share of private cars will continue to increase strongly in developing regions and fall only slightly in developed economies.
...CO2 Emissions from Global Freight Alone Could Increase by 160%...

Source: ITF/OECD, 2017
Over the next 15 years, passenger air traffic could grow between 3% and 6% annually, with intra-Asian routes growing fastest at almost 10%. CO2 emissions from international aviation could grow around 56% between 2015 and 2030, even with much improved fuel efficiency.
Under IEA/IRENA scenarios, biofuels would play an increasingly important role, in particular road freight, aviation and shipping: shortly before 2050, more biofuels are consumed in the transportation sector than gasoline and by 2050, consumption of biofuels would reach almost 12 mboe/d.

Along with fuel economy, the main means to decarbonize transport is electrification and a substantial uptake of advanced biofuels in aviation and shipping. By 2050, nearly 60% of all fuels in the transport sector would need to be low carbon (from 3% today).
BIOFUELS
RFS Developments (or Non)
My View: Point of Obligation Not Going to Change

- Point of obligation issue still pending in the RFS program
  - I argue the balance is not in CVR’s favor with the majors, biofuels, retailers, trucking and railroad industries dead against
- Now 23 Senators in a bipartisan letter have appealed to Trump to leave the point of obligation where it is
Icahn May Be Fighting a Losing Battle on the Point of Obligation


Light green states alone represent:

- 77% of total ethanol nameplate capacity
- 82% of electoral votes cast for Trump
- 55% of the popular vote for Trump

Light green = states with ethanol facilities that voted for Trump, Dark green = voted for Trump and Senator represented in letter; light blue = did not vote Trump, but Senator represented in letter.
## Is Corn Ethanol Going to Be an Advanced Biofuel?

*CI Continues to Decrease, How Much Lower Can It Get?*

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Current Average CI Range (gCO₂e/MJ)</th>
<th>2017 Average CI</th>
<th>2017 # Pathways</th>
<th>2014 Average CI</th>
<th>2014 # Pathways</th>
<th>2009 Average CI</th>
<th>2009 # Pathways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline (CARBOB)</td>
<td>99.78-99.78</td>
<td>99.78</td>
<td>1</td>
<td>99.18</td>
<td>1</td>
<td>95.86</td>
<td>1</td>
</tr>
<tr>
<td>Corn Ethanol</td>
<td>53.49-85.58</td>
<td>72.56</td>
<td>82</td>
<td>88.65</td>
<td>35</td>
<td>93.5</td>
<td>13</td>
</tr>
<tr>
<td>Sugarcane Ethanol</td>
<td>32.82-54.37</td>
<td>45.74</td>
<td>62</td>
<td>68.8</td>
<td>6</td>
<td>66.06</td>
<td>3</td>
</tr>
<tr>
<td>CNG</td>
<td>-272.97 to 90.33</td>
<td>40.77</td>
<td>53</td>
<td>40.1</td>
<td>4</td>
<td>40.1</td>
<td>4</td>
</tr>
<tr>
<td>LNG</td>
<td>34.72-87.73</td>
<td>54.24</td>
<td>18</td>
<td>55.2</td>
<td>9</td>
<td>30.9</td>
<td>3</td>
</tr>
<tr>
<td>Electricity</td>
<td>105.16-105.16</td>
<td>105.16</td>
<td>1</td>
<td>114.4</td>
<td>2</td>
<td>114.4</td>
<td>2</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>-12.65 to 151.01</td>
<td>97.39</td>
<td>7</td>
<td>109.7</td>
<td>5</td>
<td>109.7</td>
<td>5</td>
</tr>
<tr>
<td>Diesel</td>
<td>102.01-102.01</td>
<td>102.01</td>
<td>1</td>
<td>98.03</td>
<td>1</td>
<td>94.71</td>
<td>1</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>8.63-61.94</td>
<td>33.97</td>
<td>58</td>
<td>28.7</td>
<td>5</td>
<td>36.95</td>
<td>3</td>
</tr>
<tr>
<td>Renewable Diesel</td>
<td>16.89-37.39</td>
<td>29.84</td>
<td>9</td>
<td>47.4</td>
<td>3</td>
<td>47.4</td>
<td>3</td>
</tr>
</tbody>
</table>

*Source: Future Fuel Strategies, March 2017 citing data CARB*
Corn Ethanol Could End Up with a CI of about 20, Lower than Many Cellulosic Ethanols

- Implications: (1) no “need” for cellulosicethanols? (2) may lead to campaign for state LCFS’ (3) supports GHG friendly argument (4) other countries will follow California’s lead without needing to implement a LCFS (5) will support opening export markets (6) may threaten oxygenate competitors such as MTBE and MMT.
EU’s Climate & Energy Package
The Commission’s Attempt to Inject Certainty May Have Introduced More Uncertainty

Recap of Key Policy Provisions
- The level of this obligation is progressively increasing from 1.5% in 2021 (in energy terms) to 6.8% in 2030, including at least 3.6% of advanced biofuels.
- A cap on the contribution of food-based biofuels towards the EU renewable energy target has been introduced, starting at 7% in 2021 and going down progressively to 3.8% in 2030.

Developments & Intelligence
- Policy does not recognize “bridge role” of 1G-2G.
- MEPs vote to ban palm oil, not binding.
  - Palm oil represents 13% of biofuels feedstock used in EU.
- Enviros: There are no good food-based biofuels, period. What DO they want?
- Insiders tell me the 7% cap will not remain as is.
- Key member states will have a fundamental impact.
- California actions on biofuels may isolate the Commission.
ZERO EMISSION VEHICLES
The share of electric cars in passenger car sales would have to rise from less than 1% today to almost 70% in 2050.

Primarily a challenge for the G20 group, which hold more than 85% of the global passenger car stock in 2050: the largest increase in electric car sales in the 66% 2°C Scenario occurs in the large vehicle markets such as China, India, the U.S. and EU.
### Auto Industry Partnerships in Autonomous & Ride Sharing Technologies

#### Figure 19. Autonomous Driving/Shared Mobility Partnership Review

<table>
<thead>
<tr>
<th>OEM</th>
<th>Tech Partner(s)</th>
<th>Autonomous/Ride/Car-sharing</th>
<th>Economics</th>
<th>Key Dates</th>
<th>Partnership Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Motors</td>
<td>Uber</td>
<td>Ridesharing</td>
<td>No Data</td>
<td>Announced: November 1, 2016</td>
<td>90-day Partnership pilot</td>
</tr>
<tr>
<td>Toyota</td>
<td>Getaround</td>
<td>Carsharing</td>
<td>No Data</td>
<td>Announced: October 31, 2016; Pilot begins: January 2017</td>
<td>Investment &amp; Collaboration</td>
</tr>
<tr>
<td>Volvo</td>
<td>Autoliv</td>
<td>Autonomous</td>
<td>No Data</td>
<td>Announced: September 6, 2016; Operations begin: 2017</td>
<td>50/50 JV</td>
</tr>
<tr>
<td>Toyota</td>
<td>U of M</td>
<td>Autonomous</td>
<td>$22mn R&amp;D partnership</td>
<td>Announced: August 10, 2016</td>
<td>R&amp;D partnership</td>
</tr>
<tr>
<td>BMW</td>
<td>MBLY &amp; INTC</td>
<td>Autonomous Ridesharing</td>
<td>No Data</td>
<td>Announced: July 1, 2016; Fleet Testing: 2017; Anticipated Deployment: 2021</td>
<td>Partnership</td>
</tr>
<tr>
<td>Toyota</td>
<td>Uber</td>
<td>Ridesharing</td>
<td>&lt;$100mn investment</td>
<td>Announced: May 24, 2016</td>
<td>Investment &amp; Partnership</td>
</tr>
<tr>
<td>Fiat-Chrysler</td>
<td>Google</td>
<td>Autonomous</td>
<td>No Data</td>
<td>Announced: May 3, 2016</td>
<td>Non-exclusive JV</td>
</tr>
<tr>
<td>Nissan</td>
<td>NASA</td>
<td>Autonomous</td>
<td>No Data</td>
<td>Announced: January 8, 2015; Testing: 2015</td>
<td>Partnership</td>
</tr>
</tbody>
</table>

Source: Company reports, Citi Research
Conclusions

- **Air Pollution**: New studies seem to come out every week linking a range of health and environmental impacts to air pollution, in particular transport-related air pollution.

- **Cities**: Cities around the world are beginning to take action to mitigate this kind of air pollution and also mitigate climate change.
  - Expect some cities to take more of an activist approach when it comes to transport, especially on diesel.

- **Climate**: By the end of the year, we will know how serious countries are in implementing the Paris Agreement. So far, it is not impressive.

- **Decarbonizing Transport**: Much has been made about passenger car growth, but that will be overshadowed by freight, maritime and aviation growth and for these sectors there is no easy decarbonization solution. Major hindrance to 2°C.

- **Point of Obligation**: I don't think Icahn will prevail.

- **Corn Ethanol**: Lowering CI could be a game changer for the industry, policy and global market. Look for other “routes” that will grow this market.

- **ZEVs**: Allowing the federal tax credit to expire may kill the EV market outside of California. Unless states step in...
Questions?

Tammy Klein, Principal
Future Fuel Strategies
+1.703.625.1072 (M); tammy@futurefuelstrategies.com
http://www.futurefuelstrategies.com