ETHANOL INDUSTRY OUTLOOK

For - Council of State Governments - Midwest

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Renewable Fuels Association

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Who We Are and What We Stand For

RFA is the national trade association for America’s ethanol producers

- We represent companies that own and operate more than 60 ethanol biorefineries and other renewable fuel facilities across the United States.

- Our membership also includes biofuel advocates, technology providers, vendors, farmers and others who contribute to the renewable fuels value chain.

Celebrating 40 Years of Leadership

- Founded in 1981, RFA is the nation’s oldest and most experienced biofuels advocacy organization.

- We’ve been at the forefront of every major legislative, regulatory, and legal victory in the industry’s history.
Ethanol Industry Profile

U.S. ETHANOL BIOREFINERIES BY STATE

HISTORICAL BIOREFINERY COUNT & PRODUCTION CAPACITY

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed Ethanol Biorefineries</th>
<th>Total Installed Production Capacity (mgy)</th>
<th>Average Capacity per Biorefinery (mgy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>56</td>
<td>2,007</td>
<td>36</td>
</tr>
<tr>
<td>2005</td>
<td>95</td>
<td>4,294</td>
<td>45</td>
</tr>
<tr>
<td>2010</td>
<td>204</td>
<td>14,073</td>
<td>69</td>
</tr>
<tr>
<td>2015</td>
<td>214</td>
<td>15,594</td>
<td>73</td>
</tr>
<tr>
<td>2020</td>
<td>208</td>
<td>17,436</td>
<td>84</td>
</tr>
</tbody>
</table>

Source: RFA  * As of December for each year specified
Current State of the US Ethanol Industry…

- **Current state of production:**
  - Year 2000 – 56 plants, 2 BG annual capacity, ave. cap. 36 MGY/plant.
  - Year 2020 – 208 plants, 17.4 BG annual capacity, ave. cap. 83 MGY/plant.
  - Over 5 billion bushels of corn begins being processed at a US ethanol plant.
  - In 2020, ethanol added $1.27, or 37% to every bushel of corn processed.
  - In 2020, 62,180 direct jobs, 242,600 indirect jobs, $18.6B household income, $34.7B in GDP contribution.

- **Renewable fuels has weathered a multi-year storm:**
  - Dozens of Small Refinery Exemption’s (SREs) issued from 2017-2020
  - Renewable Volume Obligations (RVO’s) not being met
  - The battle for year-round E-15, Trump giveth, 10th Circuit taketh away
  - COVID-19 pandemic, lost demand leads to indirect loss of $5 billion
  - 200,000 barrels/day remain off-line, or transitioned to industrial use

- **Preserve what we have, expand where we can:**
  - Rebuild and fortify the RFS (legislative, regulatory, legal)
  - Explore other opportunities (low carbon, new uses, exports)
Ethanol biorefineries offer skilled jobs and good wages in rural communities where attractive employment opportunities are often hard to find.

1 in 5 employees is a military veteran—more than triple the national average.

Ethanol Has a Substantial Economic Impact

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct jobs</td>
<td>68,542</td>
<td>62,180</td>
</tr>
<tr>
<td>Indirect/Induced jobs</td>
<td>277,389</td>
<td>242,600</td>
</tr>
<tr>
<td>Household income</td>
<td>$22.9 billion</td>
<td>$18.6 billion</td>
</tr>
<tr>
<td>GDP contribution</td>
<td>$42.8 billion</td>
<td>$34.7 billion</td>
</tr>
</tbody>
</table>
Historical U.S. Ethanol Production

Source: RFA and U.S. Energy Information Administration
State Activity Around the Country…

• Numerous states exploring/passing legislation focused on LCFS:
  • CA’s LCFS - 10 years old, setting a trend.
    • State policy focuses ratcheting down the amount of carbon emissions allowed from energy sources.
    • Initially touted as a policy favoring EV’s, over 80% of the LCFS reduction requirements have been met by biofuels.
  • Oregon and Washington have more reasonable LCFS.
  • Other states continue LCFS/CFS policy development (Minnesota, New Mexico).
  • Numerous states/entities looking at a Midwest clean fuels policy standard
    https://www.betterenergy.org/blog/midwestern-clean-fuels-policy-101/

• CA Governor executive order - banning the sale of ICE vehicles by as year certain, others may follow.
  • This concept needs to be push back whenever possible. The focus should be on carbon reduction and technology neutral.

• Other states looking at ways to expand E15
  • States looking at some form of E15 retail requirements (IA, OH)
  • States exploring ways to opt out of the RVP 1lb waiver under EPA guidelines.
Near-term Decarbonization: Ethanol Has Been the Leading Source of GHG Savings in California

Ethanol’s Carbon Intensity Has Decreased

- Corn-based Ethanol
- Biomass-based Ethanol
- Total Ethanol
- Gasoline (CARBOB)

Ethanol has cut emissions by 26 million metric tons

Share of GHG Emissions Reductions Under the LCFS, by Fuel Type

- Ethanol: 35%
- Renewable Diesel: 27%
- Biodiesel: 15%
- Electricity: 13%
- Renewable Diesel: 27%
- Biogas: 7%
- All Other: 1%
- Natural Gas: 2%
- All Other: 1%

Source: CA Air Resources Board
Opportunities for Renewable Fuels…

• **Support legislative/regulatory efforts that could lead to increased demand**
  - Next Generation Fuels Act (high octane, low carbon)
  - LCFS/CFS legislation? Development of a carbon-based tax credit system
  - HBIIP/FFV incentives legislation
  - Need a solution for year-round E15 (legislative or regulatory)

• **How low can we go?**
  - A global movement to de-carbonize the energy/transportation sector.
  - Corn-based ethanol could be carbon-negative in the coming decades.
  - RFA members unanimously committed to 70% reduction by 2030, net zero by 2050.
  - On-farm carbon accounting, CCS technology will be important.

• **De-carbonizing could lead to new uses**
  - Bio-refining – all products made petro-chemically can be made in a bio-refinery
  - A source for hydrogen (C2H5OH)
  - Sustainable aviation fuel (SAF)
  - Ethanol to electrons
Ultra Low-Carbon Corn Ethanol Is Coming, and Ethanol Has the Potential to Be Carbon Negative

Grain Ethanol Carbon Intensity: Today and Tomorrow

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2-5 Years</th>
<th>8-10 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Intensity (Grams CO2e/MJ)</td>
<td>57.1</td>
<td>44.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Reduction v. gasoline</td>
<td>40-45%</td>
<td>50-60%</td>
<td>80-90%</td>
</tr>
<tr>
<td>Reduction</td>
<td>-15</td>
<td>-18</td>
<td></td>
</tr>
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Source: RFA analysis using GREET1_2019 and user-defined assumptions/projections
Long-term: Low-Carbon Ethanol Can Be Synergistic with Electric Vehicle Technologies

- A hybrid flex-fuel electric vehicle running on E85 flex fuel or other high-octane ethanol blend would extend vehicle range while substantially reducing GHG emissions
  - Toyota already introduced a flex-fuel hybrid Corolla in Brazil
  - Depending on sources of electricity and ethanol, vehicle can be truly “zero emissions”

- A recent study concluded: “High octane fuel vehicles with ethanol provide very similar GHG savings compared to EVs … for many states. Importantly, HOF plug-in hybrids are the lowest GHG emitting technology.”

EIA: Liquid fuels continue to dominate transportation sector through 2050

Light-duty vehicle sales by technology/fuel

Transportation sector consumption by fuel

Source: Energy Information Administration, 2021 Annual Energy Outlook
Approximately two thirds of voters agree that ethanol should be part of the strategy to achieve zero emissions economywide by 2050 (68%), helps diversify America’s fuel supply (71%), and can help ease price spikes that come from disasters (64%).

Based on what you know, do you agree or disagree with the following statements?

**Ethanol helps reduce carbon emissions from automobiles and should be part of the strategy to achieve zero emissions economywide by 2050.**
- Strongly agree: 26%
- Somewhat agree: 42%
- Don't know/no opinion: 18%
- Somewhat disagree: 9%
- Strongly disagree: 5%

**Total agreement:** 68%

**Ethanol helps diversify America’s fuel supply**
- Strongly agree: 23%
- Somewhat agree: 48%
- Don't know/no opinion: 16%
- Somewhat disagree: 10%
- Strongly disagree: 4%

**Total agreement:** 71%

**Ethanol can help ease price spikes that come from disasters like hurricanes and cyber-attacks against petroleum pipelines.**
- Strongly agree: 22%
- Somewhat agree: 42%
- Don't know/no opinion: 19%
- Somewhat disagree: 11%
- Strongly disagree: 5%

**Total agreement:** 64%