Workshop on
Low Carbon Fuel Standard

Proposed Compliance Curves and Cost Compliance Provision

October 27, 2014

Compliance Curve Agenda

• Potential compliance curves
• Illustrative example
  – Fuel volumes
  – Fuel CIs
  – Credits earned and spent
• Discussion throughout
### Compliance Curves

- 10 percent by 2020
- Compliance period: 2016 – 2020
- Basis:
  - Availability of fuels
  - Availability of banked credits (not to exhaustion)
  - Giddy up

### Compliance Curves (Cont.)

**Three Potential Approaches Considered**

- Return to existing compliance curve
- Draw straight line to 2020
- Develop more gradual path
**Potential Compliance Curves**

**Alternative Compliance Curves Under Consideration**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>More Gradual Path to 10% in 2020</td>
<td>-1.0%</td>
<td>-2.5%</td>
<td>-4.0%</td>
<td>-6.0%</td>
<td>-8.0%</td>
<td>-10.0%</td>
</tr>
<tr>
<td>Straight Line to 10% in 2020</td>
<td>-1.0%</td>
<td>-2.8%</td>
<td>-4.6%</td>
<td>-6.4%</td>
<td>-8.2%</td>
<td>-10.0%</td>
</tr>
<tr>
<td>Base Case - 10% in 2020</td>
<td>-1.0%</td>
<td>-3.5%</td>
<td>-6.0%</td>
<td>-6.5%</td>
<td>-8.0%</td>
<td>-10.0%</td>
</tr>
</tbody>
</table>

---

**Illustrative Compliance Scenario**

- LCFS remains fuel-neutral and performance-based
- Scenario based on plausible, illustrative fuel volume availability
- Each regulated party can choose preferred path to compliance
### Key Cls for Establishing Baselines

<table>
<thead>
<tr>
<th>Fuel</th>
<th>CI (gCO₂/MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBOB</td>
<td>100.49</td>
</tr>
<tr>
<td>CaRFG</td>
<td>99.49</td>
</tr>
<tr>
<td>CARB Diesel</td>
<td>102.73</td>
</tr>
</tbody>
</table>

### ZEV Assumptions

<table>
<thead>
<tr>
<th>Year</th>
<th>Total ZEVs</th>
<th>FCVs</th>
<th>LCFS Credits (MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>120,000</td>
<td>1,000</td>
<td>0.35</td>
</tr>
<tr>
<td>2015</td>
<td>200,000</td>
<td>2,000</td>
<td>0.58</td>
</tr>
<tr>
<td>2016</td>
<td>300,000</td>
<td>4,000</td>
<td>0.83</td>
</tr>
<tr>
<td>2017</td>
<td>400,000</td>
<td>10,000</td>
<td>1.07</td>
</tr>
<tr>
<td>2018</td>
<td>500,000</td>
<td>20,000</td>
<td>1.29</td>
</tr>
<tr>
<td>2019</td>
<td>625,000</td>
<td>30,000</td>
<td>1.56</td>
</tr>
<tr>
<td>2020</td>
<td>750,000</td>
<td>40,000</td>
<td>1.80</td>
</tr>
</tbody>
</table>
### Fuel Volumes for Gasoline Standard
(Illustrative - Straight Line)

<table>
<thead>
<tr>
<th>Biofuel</th>
<th>Units</th>
<th>12 mos.</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Ethanol</td>
<td>mm gal</td>
<td>1,212</td>
<td>1,200</td>
<td>1,100</td>
<td>1,000</td>
<td>825</td>
<td>750</td>
<td>700</td>
</tr>
<tr>
<td>Cane Ethanol</td>
<td>mm gal</td>
<td>73</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>350</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Sorghum/Corn Ethanol</td>
<td>mm gal</td>
<td>117</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sorghum/Corn/Wheat Slurry Ethanol</td>
<td>mm gal</td>
<td>48</td>
<td>50</td>
<td>50</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Cellulosic Ethanol</td>
<td>mm gal</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>15</td>
<td>50</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Molasses Ethanol</td>
<td>mm gal</td>
<td>6</td>
<td>20</td>
<td>40</td>
<td>40</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Renewable Gasoline</td>
<td>mm gal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>DGE</td>
<td>0</td>
<td>0.6</td>
<td>1.1</td>
<td>2.7</td>
<td>5.5</td>
<td>8.2</td>
<td>10.9</td>
</tr>
<tr>
<td>Electricity for LDVs</td>
<td>MWH</td>
<td>119</td>
<td>660</td>
<td>985</td>
<td>1,300</td>
<td>1,600</td>
<td>2,000</td>
<td>2,400</td>
</tr>
</tbody>
</table>

### CIs for Gasoline Standard
(Illustrative)

<table>
<thead>
<tr>
<th>Biofuel</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Ethanol</td>
<td>75.0</td>
<td>73.5</td>
<td>72.0</td>
<td>70.6</td>
<td>69.2</td>
</tr>
<tr>
<td>Cane Ethanol</td>
<td>50.0</td>
<td>49.0</td>
<td>48.0</td>
<td>47.1</td>
<td>46.1</td>
</tr>
<tr>
<td>Sorghum/Corn Ethanol</td>
<td>75.0</td>
<td>73.5</td>
<td>72.0</td>
<td>70.6</td>
<td>69.2</td>
</tr>
<tr>
<td>Sorghum/Corn/Wheat Slurry Ethanol</td>
<td>64.0</td>
<td>62.7</td>
<td>61.5</td>
<td>60.2</td>
<td>59.0</td>
</tr>
<tr>
<td>Cellulosic Ethanol</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Molasses Ethanol</td>
<td>22.1</td>
<td>22.1</td>
<td>22.1</td>
<td>22.1</td>
<td>22.1</td>
</tr>
<tr>
<td>Renewable Gasoline</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>
**Fuel Volumes for Diesel Standard**  
*(Illustrative - Straight Line)*

<table>
<thead>
<tr>
<th>Biofuel</th>
<th>Units</th>
<th>12 mos.</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy Biodiesel</td>
<td>mm gal</td>
<td>3</td>
<td>5</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Waste Grease Biodiesel</td>
<td>mm gal</td>
<td>37</td>
<td>40</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Corn Oil Biodiesel</td>
<td>mm gal</td>
<td>21</td>
<td>40</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Tallow Biodiesel</td>
<td>mm gal</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Canola Biodiesel</td>
<td>mm gal</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Renewable Diesel</td>
<td>mm gal</td>
<td>139</td>
<td>180</td>
<td>260</td>
<td>290</td>
<td>320</td>
<td>360</td>
<td>400</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>mm DGE</td>
<td>130</td>
<td>155</td>
<td>180</td>
<td>205</td>
<td>205</td>
<td>190</td>
<td>120</td>
</tr>
<tr>
<td>Renewable Natural Gas</td>
<td>mm DGE</td>
<td>17</td>
<td>95</td>
<td>120</td>
<td>155</td>
<td>265</td>
<td>360</td>
<td>480</td>
</tr>
<tr>
<td>Electricity (HDV/Rail)</td>
<td>1000 MWH</td>
<td>0</td>
<td>0</td>
<td>894</td>
<td>894</td>
<td>894</td>
<td>894</td>
<td>894</td>
</tr>
</tbody>
</table>

**Cls for Diesel Standard**  
*(Illustrative)*

<table>
<thead>
<tr>
<th>Biofuel</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy Biodiesel</td>
<td>50.0</td>
<td>49.5</td>
<td>49.0</td>
<td>48.5</td>
<td>48.0</td>
</tr>
<tr>
<td>Waste Grease Biodiesel</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Corn Oil Biodiesel</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Tallow Biodiesel</td>
<td>37.2</td>
<td>37.2</td>
<td>37.2</td>
<td>37.2</td>
<td>37.2</td>
</tr>
<tr>
<td>Canola Biodiesel</td>
<td>73.2</td>
<td>73.2</td>
<td>73.2</td>
<td>73.2</td>
<td>73.2</td>
</tr>
<tr>
<td>Renewable Diesel</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td>LNG</td>
<td>90.9</td>
<td>90.0</td>
<td>89.1</td>
<td>88.2</td>
<td>87.4</td>
</tr>
<tr>
<td>CNG</td>
<td>77.9</td>
<td>77.1</td>
<td>76.3</td>
<td>75.5</td>
<td>74.8</td>
</tr>
<tr>
<td>Renewable LNG</td>
<td>37.7</td>
<td>37.3</td>
<td>37.0</td>
<td>36.6</td>
<td>36.2</td>
</tr>
<tr>
<td>Renewable CNG</td>
<td>34.6</td>
<td>34.2</td>
<td>33.9</td>
<td>33.6</td>
<td>33.2</td>
</tr>
</tbody>
</table>
Low-CI Biofuels 2016 – 2020
(Illustrative)

Low CI Fuels That Produce LCFS Credits
MMTs of Credits in 2020

- Conv. NG, 0.2
- Renewable NG, 3.7
- Renewable Diesel, 3.1
- Biodiesel, 1.7
- Sugar-Based Ethanol, 1.7
- Cell. ETOH/Ren. Gasoline, 0.6
- Elec. and H2, 2.0
- Starch-Based ETOH, 1.5

2020 Credits from Low-CI Fuels
(Illustrative)
Banked Credits (Illustrative)

- After 2014 Q2, 3.5 million “excess” credits in the system
- Through 2015 Q4, expected to exceed 10 million excess credits
- With illustrative fuel volumes and CIs, excess credits may continue to rise for another year or two
- Excess credits drawn down over time, but not exhausted

Earning/Spending Credits (Illustrative)

![Amount of Banked Credits At The End of Each Compliance Year](chart)

- More Gradual Path to 10% in 2020
- Straight Line to 10% in 2020
- Current Rule Compliance Curve
Summary

• Target remains the same: 10 percent by 2020
• Several pathways to get there
• Proposed compliance curves supported by:
  – Reasonable assumptions regarding fuel volumes and CIs
  – Continued draw-down of banked credits
Cost Containment

1. Selection of Approach
   • Need for Cost Containment
   • Credit Window
   • Credit Clearance

2. Proposed Threshold
3. Proposed Interest Rate
4. Discussion of Floor
**Need for Cost Containment Provision**

- Currently, regulated parties must meet carbon intensity standards each year
- Enables compliance in the event of tight credit supply in order to avoid the possibility of a low-probability but high-impact price spike
  - ARB does not anticipate the prices will get this high
  - Clear, predictable cost containment provision reduces the risk of the market prices reaching the ceiling price
  - Even speculation of a shortage can destabilize the market
  - Uncertainty adversely affects conventional and low-CI fuel suppliers
  - Cost containment protects regulated parties and consumers

**Purpose of Cost Containment Provision**

- **Purpose:**
  - Ensure that the LCFS achieves maximum GHG emissions reductions within a reasonable and predictable range of costs
- **Goals:**
  - Provides additional compliance options
  - Strengthens incentives to invest in low-CI fuels
  - Increases certainty regarding the maximum cost of compliance
1. Selection of Approach

   • Need for Cost Containment
   • Credit Window
     • Credit Clearance

2. Proposed Threshold

3. Proposed Interest Rate

4. Discussion of Floor

Credit Window

Credit Window would allow regulated parties to purchase and retire compliance-only credits

• ARB would offer credits for sale at a pre-determined price
• Regulated parties purchase credits needed for that year’s compliance
• Funds collected from the sale of compliance credits would be distributed to low-CI fuel producers to further incentivize production
**Credit Window (Cont.)**

- Staff not proposing the Credit Window as the preferred approach
- Challenges associated with the Credit Window:
  - ARB-issued credits would not represent real CI reductions
  - Problematic for ARB to sell LCFS credits
  - Unclear whether low-CI fuel producers would receive the revenues from ARB-issued credits
  - Does not fully address the Board’s concerns of stranded credits

---

**Cost Containment**

1. **Selection of Approach**
   - Need for Cost Containment
   - Credit Window
   - **Credit Clearance**

2. Proposed Threshold
3. Proposed Interest Rate
4. Discussion of Floor
Credit Clearance

- Credit Clearance option is preferred approach
- Provides a compliance mechanism in the event of tight credit supply
  - Regulated parties can carry remaining deficits after purchasing their pro rata share of credits pledged to the year-end clearance market
  - Improves market confidence in the durability of the regulation
- Automatic process at year-end to determine if there are insufficient credits available for compliance
  - Clearance market transactions would only occur if there are insufficient credits available for compliance
- Clearance credits would be offered at or below a pre-determined price
  - Provides strong and transparent price cap year-round

Comparison of the Options

<table>
<thead>
<tr>
<th>Design Feature</th>
<th>Credit Clearance</th>
<th>Credit Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP credits represent real CI reductions</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ARB collects funds</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Easy to develop and implement</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Establish confidence in credit prices</td>
<td>Increased</td>
<td>Increased</td>
</tr>
<tr>
<td>Certainty regarding cost of compliance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recipient of revenues from CCP</td>
<td>Low-CI fuel producers</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Preserve Environmental Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extract maximum environmental benefits in the current year</td>
<td>Yes</td>
<td>Uncertain</td>
</tr>
<tr>
<td>LCFS targets are fully met in the long-term</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Strengthens incentives to produce and invest in low-CI fuels</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Credit Clearance
Benefits to Regulated Parties

Conventional Fuel Suppliers
- Maintains limit on credit prices
- Decreases risk of serious price spike
- Increases certainty regarding the maximum cost of compliance
- Enables compliance using credits generated by low-CI fuels available in the market
- Accumulated deficits are likely to be repaid below the capped price

Low-Carbon Fuel Suppliers
- Maintains limit on credit prices
- Decreases risk of serious price spike
- Improves market durability, increasing investor confidence and increasing supplies of low-CI fuels
- Ensures that producers and investors can more confidently assess the market value for low-CI fuels and credits, stimulating investments

Cost Containment

1. Selection of Approach
   - Need for Cost Containment
   - Credit Window
   - Credit Clearance

2. Proposed Threshold

3. Proposed Interest Rate

4. Discussion of Floor
Price Threshold

- Price cap will be implemented through year-end clearance market
  - Sellers pledging credits must agree to sell at or below pre-established price
- Price cap will enhance the operation of LCFS credit market
  - Will cap the prices of LCFS credits all year
  - Limits effects of extreme volatility and/or supply shortages
  - Strong, transparent price cap will improve confidence in durability of regulation under all scenarios

Price Cap

Credit Prices

<table>
<thead>
<tr>
<th>Past Years</th>
<th>Future Years</th>
</tr>
</thead>
</table>

Price cap
Price Threshold

- Staff proposes a price cap of $200/credit (1 MTCO$_2$e) in 2016
  - National LCFS Study
  - Aligns with British Columbia’s *Renewable and Low Carbon Fuel Regulation* Administrative Penalties

- Important that price cap remains constant in real dollars
  - Price cap will adjust for inflation based on CPI in subsequent years
  - Addresses hoarding concerns because credits will not be worth more in later years

Cost Containment

1. Selection of Approach
   - Need for Cost Containment
   - Credit Window
   - Credit Clearance

2. Proposed Threshold

3. Proposed Interest Rate

4. Discussion of Floor
**Interest Rate**

- Accumulated deficits will be charged small annual interest rate to incent timely repayment
- Staff proposes setting the interest rate at 3 percent
  - Interest is applied in terms of deficits and would be added to regulated party’s accumulated deficits at year-end
- Example: a regulated party with 100 accumulated deficits would be charged “interest” of 3 additional deficits for that year

---

**Interest Rate Examples**

**Scenario 1**

<table>
<thead>
<tr>
<th></th>
<th>year 1</th>
<th>year 2</th>
<th>year 3</th>
<th>year 4</th>
<th>year 5</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficits Carried Over</td>
<td>0</td>
<td>1,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,000</td>
</tr>
<tr>
<td>Deficits Repaid</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>250</td>
<td>803</td>
<td>1,053</td>
</tr>
<tr>
<td>Interest charged*</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>23</td>
<td>0</td>
<td>53</td>
</tr>
<tr>
<td>Total Accumulated</td>
<td>0</td>
<td>1,000</td>
<td>1,030</td>
<td>803</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Interest is applied as additional deficits, which are added to the regulated party’s accumulated deficits account.
**Interest Rate Examples (Cont.)**

Scenario 2

<table>
<thead>
<tr>
<th></th>
<th>year 1</th>
<th>year 2</th>
<th>year 3</th>
<th>year 4</th>
<th>year 5</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficits Carried Over</td>
<td>1,000</td>
<td>700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,700</td>
</tr>
<tr>
<td>Deficits Repaid</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>1,320</td>
<td>1,820</td>
</tr>
<tr>
<td>Interest charged*</td>
<td>0</td>
<td>30</td>
<td>52</td>
<td>38</td>
<td>0</td>
<td>120</td>
</tr>
<tr>
<td>Total Accumulated</td>
<td>1,000</td>
<td>1,730</td>
<td>1,782</td>
<td>1,320</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Interest is applied as additional deficits, which are added to the regulated party’s accumulated deficits account.

---

**Cost Containment**

1. **Selection of Approach**
   - Need for Cost Containment
   - Credit Window
   - Credit Clearance

2. Proposed Threshold

3. Proposed Interest Rate

4. **Discussion of Floor**
**Price Floor**

**Benefits**
- Stimulate investments in low-CI fuels
- Provide clear market signal regarding the minimum credit price
- Lenders have more confidence in value of LCFS credits
- Facilitate long-term business planning for low-CI fuel producers

**Potential Drawbacks**
- Risk of setting floor at incorrect level:
  - Too high: lost gains from trade
  - Too low: may not deliver intended benefits
- May artificially inflate cost of compliance
  - May not deliver additional environmental benefits

---

**Price Floor (Cont.)**

- If LCFS is working as planned, would a floor be necessary?
  - If LCFS credit prices are low, sufficient credits/fuels are in the market
  - If LCFS credit prices are well above any proposed floor price, what additional value does a floor provide?
- What is the appropriate price floor threshold to achieve the intended benefits?
  - September 2014 LCFS credit prices ranged from $24 - $29
  - Where should the floor price be set?
Potential approach to implement if floor is considered: disallow trades in LRT at sub-floor prices

• Would require all credit trades have reported values

• No $0 credit transactions (i.e., bundled credits), which account for nearly 1-in-5 credit transactions
**Next Steps**

- Feedback due November 17, 2014
- Submit via email to Katrina Sideco at ksideco@arb.ca.gov
- Staff report – December 2014
- Board Hearing – February 2015

---

**Contact Information**

**Mike Waugh**, Chief, Transportation Fuels Branch  
(916) 322-8263, mwaugh@arb.ca.gov

**Wes Ingram**, Manager, Fuels Evaluation Section  
(916) 322-3984, wingram@arb.ca.gov

**Adrian Cayabyab**, Air Resources Engineer, Fuels Section  
(916) 327-1515, acayabya@arb.ca.gov

**Kirsten Cayabyab**, Air Pollution Specialist, Fuels Evaluation Section  
(916) 327-5599, kking@arb.ca.gov
Thank You