Workshop Overview

- Background and regulatory history
- Population and activity survey
- 2020 Rulemaking
- Reducing fuel spills and drips
- Transitioning to zero emissions
- Rulemaking process
Background and Regulatory History
Small Off-Road Engines (SORE)
Sources of Emissions

During operation:
Exhaust and evaporative

During storage:
Evaporative
SORE Regulatory History

1990
Exhaust standards adopted

1995-1996
Tier 1 exhaust standards implemented

2000-2002
Tier 2 exhaust standards implemented

2003
Tier 3 exhaust standards and first evap standards adopted

2005-2013
Tier 3 exhaust and evap standards implemented

2008-2015
Evap validation studies

2016
Evap amendments adopted
SORE Emissions Versus Cars
(Statewide)

- SORE emissions projected to increase
- Will surpass those from light-duty passenger cars in early 2020s
ROG Majority of SORE Emissions

Emissions (tons per day)

- ROG (CA): 80.8 tons
- ROG (Preempt): 4.4 tons
- NOx (CA): 10.3 tons
- NOx (Preempt): 21.1 tons

CARB
High Evaporative Emissions

- Certification Data: 60% Failed
- 2013-2015 Validation Study: 50% Failed
- Assumption: 50% Failed
- 2013-2015 Validation Study: 50% Failed

Compliance Rate

Performance

Design
CARB Evap Emissions Compliance Testing

- 42% have failed overall
- Fuel caps implicated
- Leaking fuel tanks
Population and Activity Survey
Survey to Update Lawn and Garden Equipment Population

- Updating equipment population to refine inventory
- Determine penetration of zero-emission equipment in California
CSUF Social Science Research Center

- Experience with statistically valid phone surveys
- Team of student callers are trained in the survey-managers are experienced callers
- Household survey captured both landlines and cell-only households
## Sample Frames

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>Occupied households that do not run a landscaping business</td>
<td>12,944,178</td>
</tr>
<tr>
<td></td>
<td>(US census)</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>Businesses, except home-based and landscaping</td>
<td>1,851,224</td>
</tr>
<tr>
<td></td>
<td>(Econ census)</td>
<td></td>
</tr>
<tr>
<td>Licensed landscapers</td>
<td>NAICS 541320 (Landscape and Architectural Services), 561730 (Landscaping Services)</td>
<td>59,385</td>
</tr>
<tr>
<td></td>
<td>(Econ census)</td>
<td></td>
</tr>
<tr>
<td>Unlicensed landscapers</td>
<td>Calculated from remaining residential demand</td>
<td>23,666</td>
</tr>
</tbody>
</table>

CARB
### Number of Surveys Conducted

<table>
<thead>
<tr>
<th>Survey</th>
<th>Number attempted to contact</th>
<th>Number completed surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>13,638</td>
<td>1,152</td>
</tr>
<tr>
<td>Business</td>
<td>8,079</td>
<td>1,350</td>
</tr>
<tr>
<td>All landscapers</td>
<td>7,247</td>
<td>629</td>
</tr>
</tbody>
</table>
Household L&G Equipment

- Occupied households in California
- Weighted to account for residence type and household size
- 16 million pieces of residential lawn and garden equipment
Business L&G Equipment

- Home-based and landscaping businesses excluded
- Weighted to account for industry and number of employees
- 800,000 pieces of lawn and garden equipment
Licensed Landscaping Business

- NAICS codes 541320 (Landscape and Architectural Services), 561730 (Landscaping Services)
- Weighted to account for sole proprietorships
Unlicensed Landscaping Business

- Calculated from remaining residential demand for landscapers
- No weighting applied
Estimating Unlicensed Landscapers

3.5M single family homes in CA using a landscaper
13M households × 58% single family × 47% use landscaper = 3.5M

2.7M households reached by licensed landscapers
53,000 landscapers × 96% service homes × 54 clients = 2.7M

24,000 unlicensed landscapers
781,000 remaining demand ÷ 33 clients = 24,000
Equipment Maintenance

- Percent of equipment owners following maintenance schedules
- “Other” usually monthly or weekly for landscapers
Survey Summary

• Residential equipment already majority electric
• Electric equipment has low adoption rate among commercial users
• Equipment frequently does not receive recommended maintenance
2020 Rulemaking
## Need for Further Reductions

### 2016 State Implementation Plan (SIP) Strategy

<table>
<thead>
<tr>
<th></th>
<th>Statewide Reductions (tons per day, expected)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\text{NO}_x$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>168</td>
</tr>
<tr>
<td><strong>SORE</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Additional Off-Road</strong></td>
<td>18</td>
</tr>
</tbody>
</table>
Future Emission Standards

• Factors for consideration
  • Updated emission inventory
  • State Implementation Plan
  • Technological feasibility
  • Mobile Source Strategy
Exhaust Emission Rates (Class 1-2)
Exhaust Emission Standards (Class 3-5)
Future Exhaust Emission Standards

• Reduce maximum emission rates (FEL caps)
• Revisit emission durability periods
• Continue use of ABT emission reduction credit program
• Amend ZEE emission reduction credit program
Evaporative Emission Standards (> 80 cc)

Class 1 (80 cc < disp. < 225 cc)  
- Standard Up to 60%

Class 2 (disp. ≥ 225 cc)  
- Standard Up to 86%  
- Lowest Certified 97%

Diurnal Emissions (g HC/day)

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Evaporative Emissions Research Testing

2-Stroke Handheld (≤ 80 cc) Baseline – Hot Soak Emissions
Evaporative Emissions Research Testing

2-Stroke Baseline – Diurnal Emissions

The chart shows the 24-hour emissions (g/day) for various equipment types, with generators and tillers having significantly higher emissions compared to other equipment types.
Future Evaporative Emission Standards

- Hot soak + diurnal emissions
  - No dependence on fuel tank volume
  - Standards for \( \leq 80 \text{ cc} \) (handheld) engines
- Revisit carbon canister working capacity determination
- Design standards
  - May be eliminated
  - No dependence on surface area
- Tests for fuel spillage
Reducing Fuel Spills and Drips
Tilt Test

- Tilt equipment 90 degrees
  - Forward
  - Backward
  - Left
  - Right

- No fuel leak in 5 minutes
Canister Contamination

- Weigh canister before and after
  - Tilt test
  - Overfill test in ANSI/OPEI B71.10
- Increase in mass suggests exposure to liquid fuel
- Installation requirement in section 2754(d)
Fuel Cap and Tether Drips

- Start with full fuel tank
- Install and remove fuel cap
- No fuel spillage from fuel cap or tether
Other Ideas?

- Ways to reduce …
  - Fuel spillage during refueling
  - Spills or leaks during use or transport
  - Problems due to improper filling or handling
Transitioning to Zero Emissions
Zero Emission Equipment Credits

• Available since 2010
• 8 equipment types
• Used to offset emissions
• First ZEE certified in 2018
• 2 manufacturers participating
  • 5 equipment types total
Transitioning to Zero Emissions

- **2020**: Adopt new emission standards
- **2031**: Ozone SIP attainment deadline
- **Zero emission standards**
  - 0 g·kWh⁻¹ (exh)
  - 0 g·day⁻¹ (evap)
- **End spark-ignition engine sales**

Credit use allowed
Rulemaking Process
Stakeholder Engagement

• Stakeholders
  • Participate in workshops and meetings
  • Share ideas to reduce emissions
  • Share test data and product information
  • Propose changes to ZEE credit program

• CARB staff
  • Public process
2020 SORE Rulemaking Timeline

2015
First workshop for 2016 evap amendments/future concepts

2018-2019
Population and activity survey

2018-2019
Exhaust and evap testing

September 2019
First workshop

2019
Emission inventory

September 2020
Propose new standards

2020
Emission inventory and proposed rule workshops
Next Steps

• Continue exhaust and evaporative testing
• Emission inventory workshop (Q1 2020)
• Develop regulatory proposal
• Regulatory proposal workshop (Q2 2020)
CARB Staff Contact Information

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