

“Dairy Biogas to Electric Vehicle Transportation Pathway” in the San Joaquin Valley

**California Dairy and Livestock Greenhouse
Gas Reduction Working Group
Digester Sub-Group**

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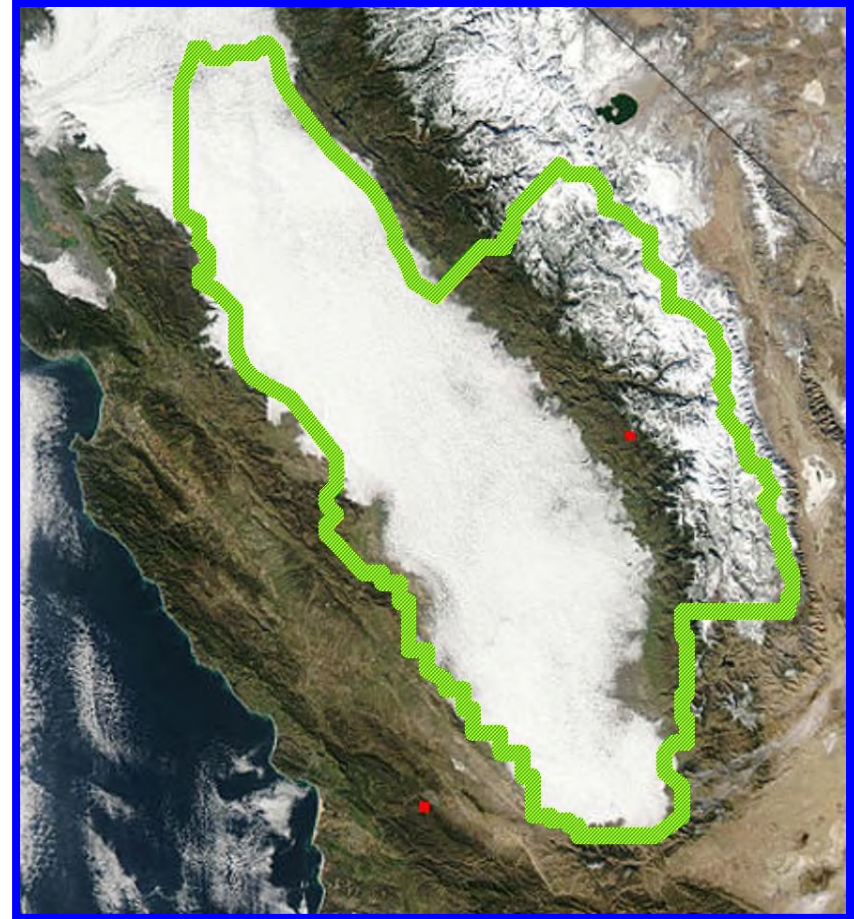


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Air Quality Challenges in the San Joaquin Valley

- Surrounding mountains and meteorology create ideal conditions for trapping air pollution
- Economic challenges – 20 of California's 30 most disadvantaged communities (CalEnviroScreen)
- Extreme nonattainment for 8-hr Ozone Standard (summer)
- Serious nonattainment for PM2.5 Standards (winter)
- NOx the most critical pollutant in the SJV for both ozone and PM2.5
- ~ 85% of NOx from mobile sources
- > 80% reduction in stationary source NOx emissions since 1980

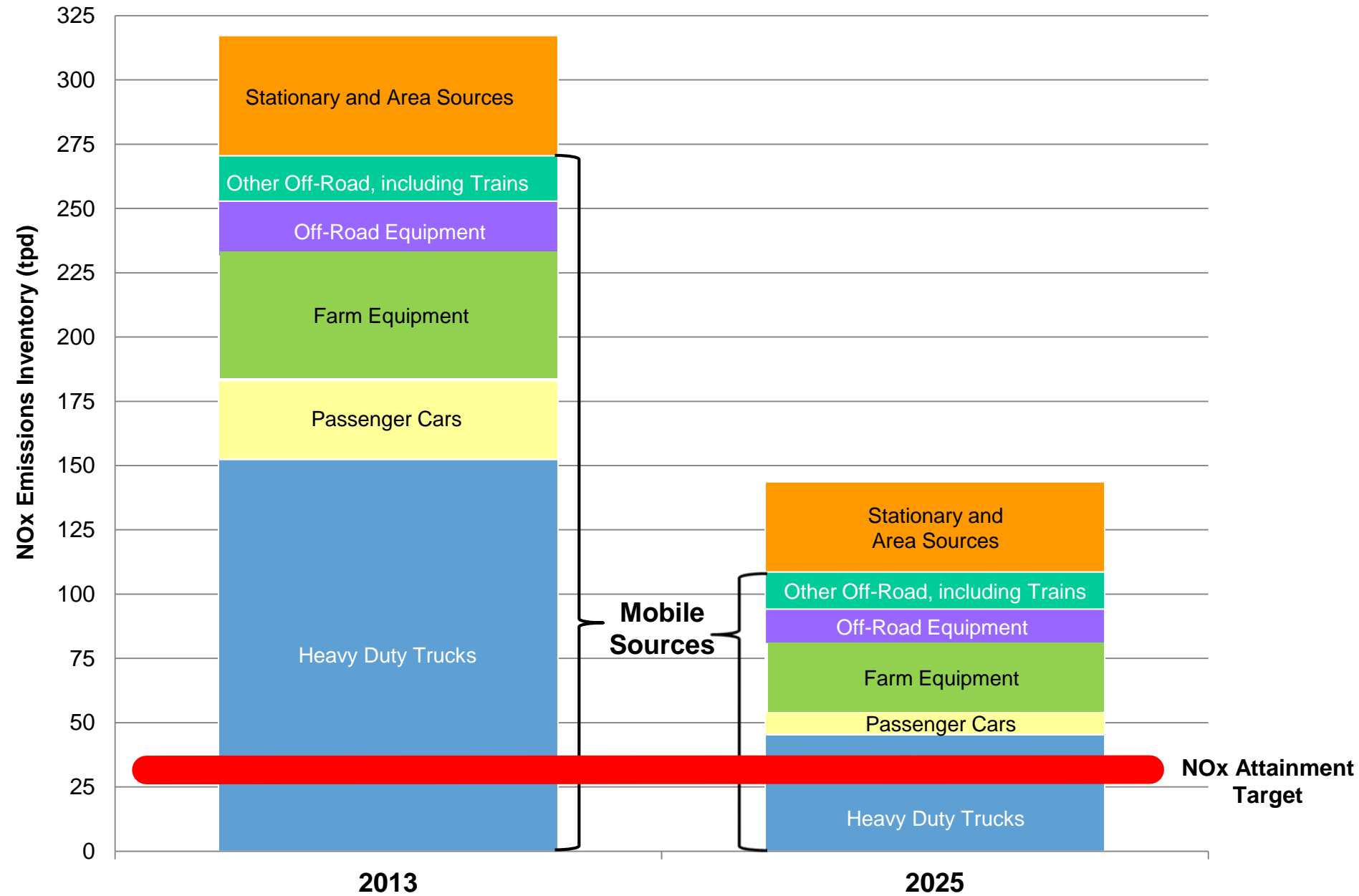


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Additional NOx Reductions Needed in SJV

(2025 Serious Deadline for 2012 Annual PM2.5 Std)



Dairy Methane Reductions and NOx

- NOx from all sources in the SJV must be reduced to meet health-based air quality standards for Valley residents
 - Currently don't know how to reduce NOx enough to get healthy air
 - So need NOx reductions, not increases
- Climate change (methane reduction) efforts that generate NOx in the Valley mean that other businesses have to reduce NOx even more – not a lot of opportunity, since we have the most stringent rules
- Biomethane burned in IC engine, used to produce on-farm power, generates new NOx emissions
 - NOx is produced at about 0.45 lb/MW-hr
- Biomethane: **pipeline injection** or **vehicle fuel**
 - Displaces fuel already being burned
 - No NOx increase
 - All of CDFA's recent grants going to such projects!



Example Dairy Methane Project

- Dairy digester serving 7000 head (single large dairy, or “cluster” piping gas to central location)
- Standard on-farm power production
 - Lean-burn engine controlled by Selective Catalytic Reduction (SCR)
 - 0.45 lb NO_x/MW-hr
 - **3300 lbs NO_x per year**
- Ultra-low NO_x on-farm power production
 - Lean-burn engine with advanced SCR, microturbines, etc.
 - 0.07 lb NO_x/MW-hr
 - **500 lbs NO_x per year**
- No-NO_x solutions:
 - Fuel cells (on-farm power production)
 - Pipeline injection
 - Use as vehicle fuel (substantial NO_x benefit if used in new 0.02 gr-NO_x/bhp-hr natural gas-fired truck engines)



Biomethane Electric Vehicle Pathway

- The question that has been posed:
 - Are there air quality advantages to using biomethane to generate on-farm power that charges electric vehicles?*
- Note that climate change benefits are NOT local air quality benefits
- Are there direct local air quality benefits?
 - All NO_x impacts are the same as on-farm power production for any other purpose (refer to prior slide)
 - **So, no direct air quality benefits, potential disbenefit**
- Are there indirect local air quality benefits?
 - Perhaps, if it increases electric vehicle use
 - However, don't see the Biomethane Electric Vehicle Pathway as generating demand or additional electric vehicle usage, and haven't seen any arguments that suggest that it does
 - **So, no identified indirect air quality benefits**
- Can support on-farm **fuel cell** power production for electric vehicle charging (no NO_x increase)

