

CalRecycle Landfill Data Summary: Part 1. Landfill Gas-To-Energy (LFGTE)

**Scott Walker, PE, CEG, Manager,
Engineering Support Branch (ESB)
Compliance and Enforcement Division (CED)
September 20, 2011**

Policy Framework- LFGTE

- CalRecycle RCRA Subtitle D Program- 27 CCR (see 4/12/11 monthly meeting presentation); Strategic Directives SD2, SD4, SD9.
- Cross-media/programmatic issues (Local Air Districts, ARB, SWRCB/RWQCBs, CEC, CPUC);
- Climate Action/AB32 Inventory/Early Action Measure; Low-Carbon Fuel Standard (AB32; EO-01-07);
- Governor's Clean Energy Jobs Plan; Bioenergy Action Plan (EO-06-06); RPS (EO-14-08; EO-21-09); AB118.

Goals of Landfill Data Collection Effort

- Maintain CalRecycle's role as state technical expert;
- Advance efforts to characterize and minimize gas greenhouse gas emissions, maximize bioenergy recovery, and protect public health, safety, and the environment;
- Assist diversion of organic waste from landfill disposal to recovery of bioenergy;
- Assist in research and development of bioenergy, climate change, and long-term landfill postclosure.

Objectives Landfill Data Collection Effort

- Emphasis: CA Landfill Gas/Bioenergy/Climate Change;
- Accurate data with minimal error on state-wide basis (not intended for site-specific regulation);
- Meet specific needs of core CalRecycle Program areas, stakeholders, project developers, and researchers;
- Minimize staff workload for custom requests;
- Consistent and compatible with Solid Waste Information System ([SWIS Home Page](#)).

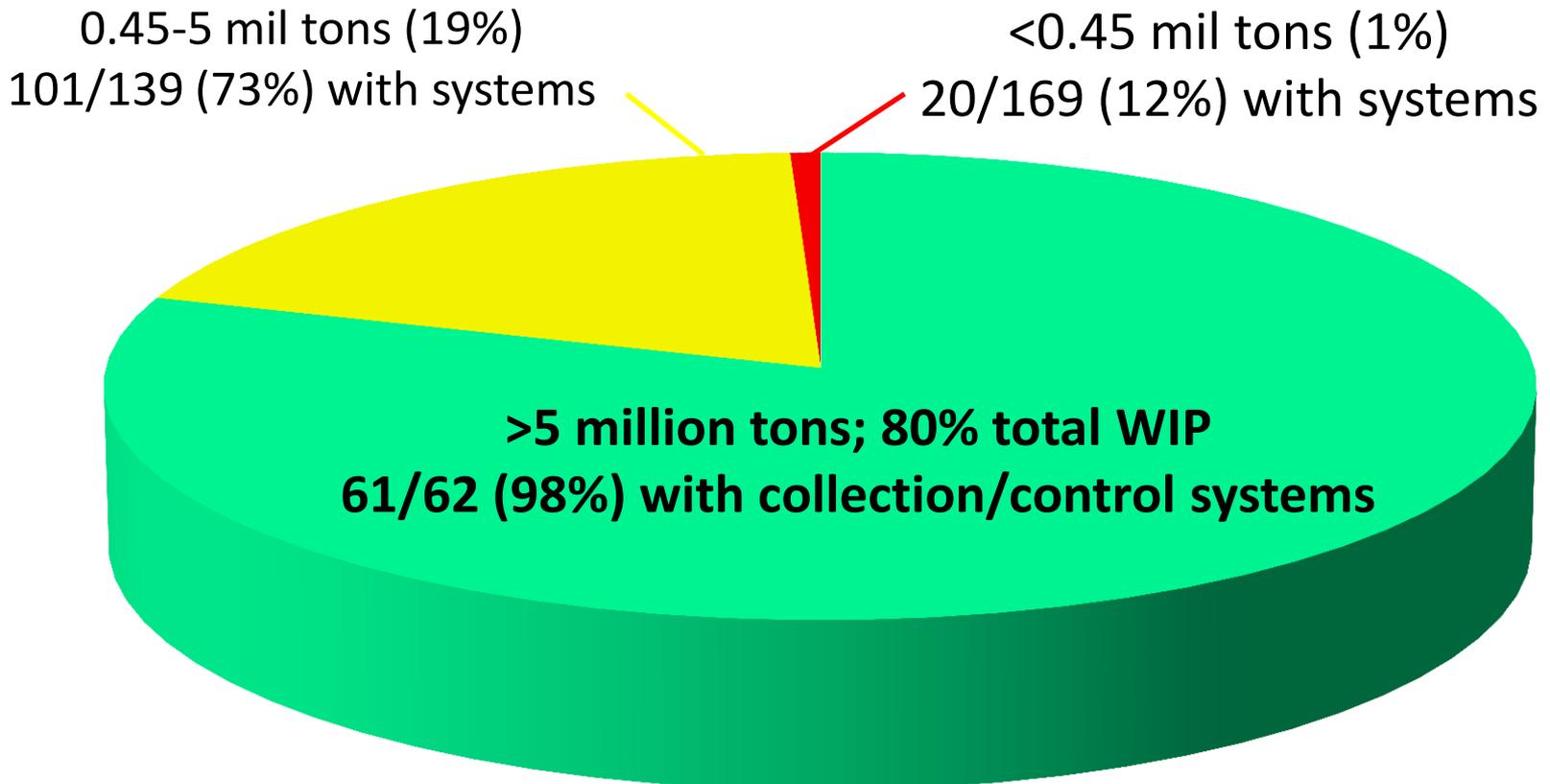
Landfill Data Protocols

- Build on earlier efforts for Landfill Gas-To-Energy Task Force 2001 and Climate Action Team 2006;
- For 2010 first compilation of actual gas collected, %methane, flared vs. recovered, and waste footprint;
- Data from site-specific files, permit documents, SWIS, Disposal Reporting System (DRS), and direct contact and surveys of landfill operators;
- Site-specific waste-in-place (WIP) calculated based on engineering judgement if actual tonnage not available.

2010 Inventory of Waste-in-Place (WIP)

1.354 billion tons WIP in 370 landfill sites with potential biomethane (118 active, 252 closed).

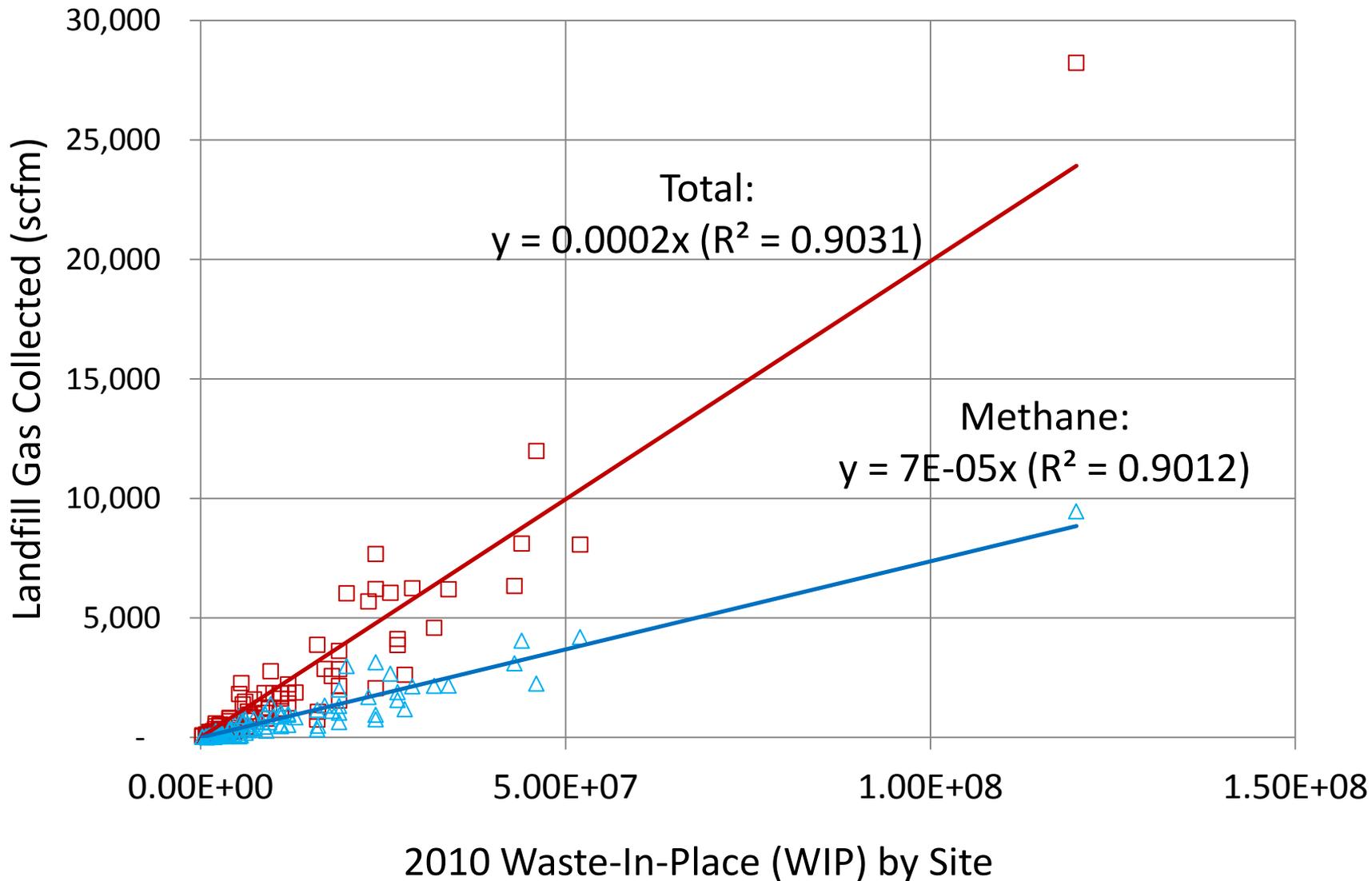
% Total WIP and Collection/Control Systems per Landfill Size:



Landfill Gas Collected 2010

- LFG collection data for 2010 obtained for 85% total WIP and 90% WIP with collection and control systems;
- 104 billion cubic feet (cf) of total gas collected with 41.5 billion cf of methane (mean 40% methane content), 51% of methane was recovered and 49% flared;
- 76 scfm mean methane per 1 MT WIP, range is 2-167 scfm per 1 MT WIP, and SD is 36 scfm.
- Correlation of LFG and methane collected to WIP (next slide):

Landfill Gas Collected 2010 (cont.)



Overview of LFGTE Systems

- Electricity Generation:

Biomethane from landfill gas otherwise flared can be used to generate electricity for onsite use or export to grid using internal combustion engines, turbines, microturbines, and other technologies (*e.g., engines- Kiefer Road LF, Sacramento County*).

- Direct Use:

Direct use of LFG (med-Btu) can offset another fuel (e.g., natural gas) in a boiler, dryer, kiln, or other thermal application (*e.g.- Sacramento 28th Street Landfill to Blue Diamond Almond*).

LFGTE Systems (cont.)

- Alternate Vehicle Fuels:

LFG converted to low carbon vehicle fuel as compressed (CNG) or liquefied (LNG) natural gas (*e.g., Altamont LF LNG project*).

- Renewable Natural Gas (RNG):

LFG can be processed and delivered to the natural gas pipeline system as high-Btu fuel (*no CA projects and current policy issue*).

- Other Technologies:

- Cogeneration (combined heat and power or CHP);
- Enhanced methane generation for recovery: LF bioreactors, landfill-based anaerobic digestion (AD), steam injection.

2010 LFGTE Production (net if available)

Electricity 261 MW (71 sites/83 projects):	
142 MW	Reciprocating (IC) Engine
111 MW	Gas and Steam Turbines
8 MW	Microturbine
Direct Use 12.5 mmscfd (9 sites/9 projects):	
9 mmscfd	Boiler Fuel and Direct Thermal (Med-Btu)
3.5 mmscfd (13,000 gpd)	Alternative Fuel LNG
Planned LFGTE:	
106 MW	Electricity (11 new sites/14 projects)
5 mmscfd (18,000 gpd)	Direct Use Alternative Fuel LNG (1 project)

LFGTE Significance in Renewable Energy Goals

- Modest increase in LFGTE as systems shutdown from declining gas are balanced by new projects;
- Significant potential to increase and maximize collection and recovery at existing large landfills (but barriers exist).
- LFG in-state electricity (CEC 2008) is 28% of biomass, 6% of total renewables, and 1% of total; LFG biofuel LNG potential to 3% of total diesel;
- Technologies to enhance recovery being demonstrated (bioreactor, LF-based AD, and leading to separate or collocated AD); possible energy resource of 1.35 billion tons WIP are vast, another consideration?

CalRecycle Landfill Data Summary: Part 1. Landfill Gas-To-Energy (LFGTE)

- Summary and conclusions (link to spreadsheets of data in posted Agenda Item and other tbd).
- Next Steps: Part 2 presentation planned for AB 32 Climate Change/Landfill Methane Capture data.
- Questions?

Scott Walker, PE, CEG, Manager,
Engineering Support Branch (ESB)

September 20, 2011

