

Lessons Learned from LFGTE Mega-Projects in Argentina & Chile and Application to Projects in North America

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South America LFGTE Mega-Projects

- Argentina 12 MW, 2012
- Chile 16 MW, 2013
- Application to North America



Central BuenAyre

6 x G3520C, 1500 rpm

12 MW

Buenos Aires, Argentina



Benito Roggio Ambiental (BR.a)

- Owner and operator of Central BuenAyre
- Member of Grupo Roggio (est.1908)
 - Long tradition in construction, transportation, water treatment, environmental solutions, other businesses.

- BR.a



- A leader in Latin America for the supply of environmental infrastructure and services.
- 25 years operating, 580 pieces of equipment
- 4,200 employees, \$245 MM (2012)



BR.a – Key Activities

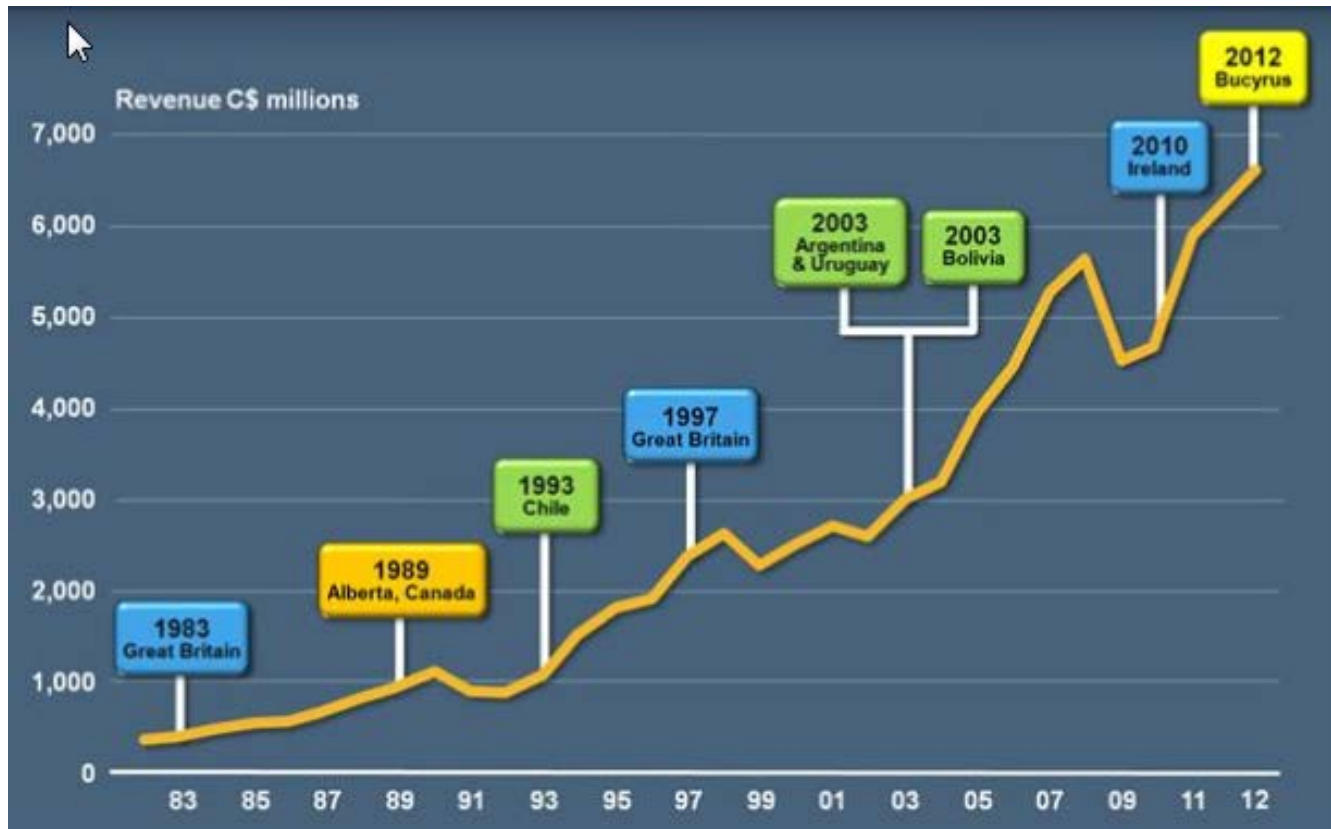


MSW collection (several cities)	1 MM tons/yr
MSW disposal (operation of 3 landfills)	6 MM tons/yr.
Mechanical-Biological treatment plant	1,000 tons/day
LFG Value-adding (electricity, other uses)	69 MM m3/yr.
Hazardous waste treatment & disposal	

- CLIBA – TECSAN – TAYM –ENERCO2



Finning International, Inc.



- Largest Caterpillar dealer in the world
- 15,300 employees, \$6.6 billion (2012)



Landfill & GCCS

- Norte III.c
- Owner: CEAMSE
- Opened in 2008
- Area: 100 ha
- MSW collection
 - 14,000+ tons/day
- Wells: 266
- Blowers:
 - 3 x 6,500 m³/hr ea.
- Flares:
 - 2 x 4,500 m³/hr ea.



Energy Project Development



Scope of Supply

- Benito Roggio Ambiental:
 - Design & Construction
 - Finning Argentina:
 - Gas cleaning equipment
 - Generator sets
 - Switchgear and controls
 - Installation & start-up
 - 10 yr. maintenance contract
 - Financing via CAT Financial
- Leveraged Finning U.K experience



Technical Solution – Central BuenAyre

- 6 x G3520C @ 1500rpm, 2MW ea.
 - 400V, 50Hz
- Requires siloxane removal equipment due to levels well above G3500 limit (e.g., 9 ppm*)

*Siloxanes (as Si), based on 500 Btu/scf fuel



Gas Cleaning Equipment



Engine Cooling & Air Handling



Central BuenAyre – Operational Status



- G3520C Factory Shipment
 - 1Q 2012
- Genset Commissioning
 - June-July 2012
- Plant Start-up:
 - Oct. 2012
- First Top-Ends
 - 8,000 – 9,000 hours
- YTD hours:
 - 9,000+



Santa Marta Power Plant

8 x G3520C, 1500 rpm

16 MW

Santiago, Chile



Consortio Santa Marta (CSM)

- Owner of Santa Marta power plant
- Established in 1998
- Mission: To provide an effective and sustainable solution for MSW management in South Metropolitan Santiago
 - Puerta Sur Transfer Station
 - Santa Marta Sanitary Landfill
- Serves 2 MM people (33% of Santiago pop.)
- 182 employees (2012)



Santa Marta Landfill

- Opened 2002, 296 ha.
- First dry landfill in Chile
 - No leachate pools
 - Green filter 40 ha.
- Flare System: 10,000 m³/hr



Energy Project Development – Santa Marta



Finning Chile Scope of Supply

(Turn-key + 6 months)

- Detailed engineering
- Procurement & construction
- Start-up
- 6-Month initial operation
 - Full operation & maintenance
 - Energy production

Leveraged Finning U.K
experience with LFGTE



Technical Solution – Santa Marta

- 8 x G3520C @ 1500rpm, 2MW ea.
 - 400V, 50Hz
- SCR required to meet strict NOx restrictions in metropolitan Santiago area
- Siloxane removal required in order to enable use of SCR on landfill gas generator set



Power House Construction



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Power House – Air Inlet Side



Generator Set Installation



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Gas Cleaning Equipment



Air Outlet & Electrical Sub-Station



Santa Marta LFGTE – Operational Status



- G3520C Factory Shipment
 - 3Q 2012
- Genset Commissioning
 - April-May 2013
- Plant Start-up:
 - Sep. 2013
- 2,000 hour maintenance
 - Dec. 2013
- Jan.'14: Approx. 2,500 hrs.



Application to North America Projects



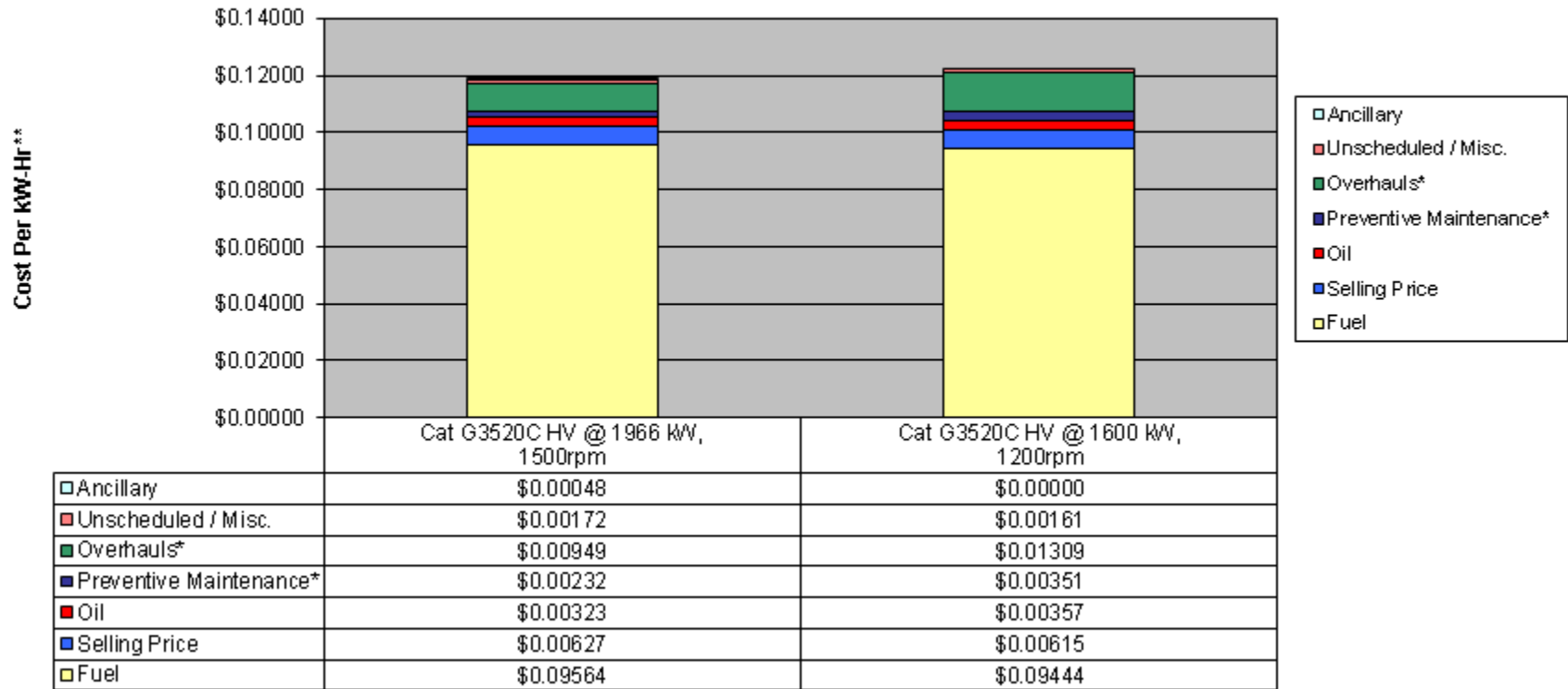
The Search for Increased Power Density

- How can I extract more power from the same engine footprint?
- G3520C used in North American LFGTE market:
 - 1200 rpm, 60Hz, 1.6 MW
 - Not easy nor inexpensive to develop 1800 rpm offering
- Alternative: Keep Engine @ 1500 rpm → gearbox → alternator end @ 1800 rpm → 60Hz, 2MW



Operation & Maintenance Cost Comparison

Life Cycle **Chart Area**



- Includes gearbox price and O&M cost in 1500 rpm unit.
- Results match real-life experience with U.K landfill units (60,000+ hours) and other int'l projects.



Thank You For Your Attention!

<http://www.catelectricpowerinfo.com/gas/>

