



SMALL CHP SYSTEMS FOR PUBLIC, NONPROFIT, & COMMERCIAL FACILITIES

CEC IEPR Workshop February 16, 2016

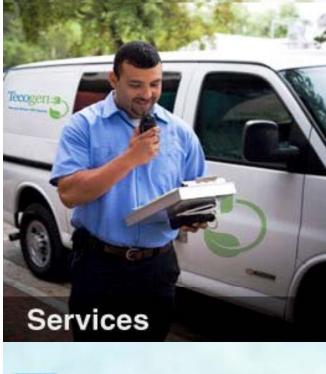
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Company Background - TECOGEN Inc.

- Founded 1982, as division of Thermo Electron Corp., with headquarters in Waltham, MA
- A leading manufacturer, installer, & servicer of small gas engine-driven CHP systems, including cogen modules (60-100 kW) & chillers
- Thousands of systems in operation, some for 25+ years







Combined Heat & Power (<500 kW)

Definition: The simultaneous production of two useful outputs (electricity + heat) from a single fuel source



or "A boiler that makes free electricity"



Sample Tecogen InVerde CHP system

6 INV-100's





Sample Tecogen CHP System

AT LOCAL BAY AREA SITE





Best Applications...

- Hospitals
- Schools
- Community Colleges
- Nursing Homes
- Retirement Residences
- Apartment Buildings/ Condos
- Athletic Clubs
- YMCA's
- Municipal Pools
- Jewish Community Centers
- Jails



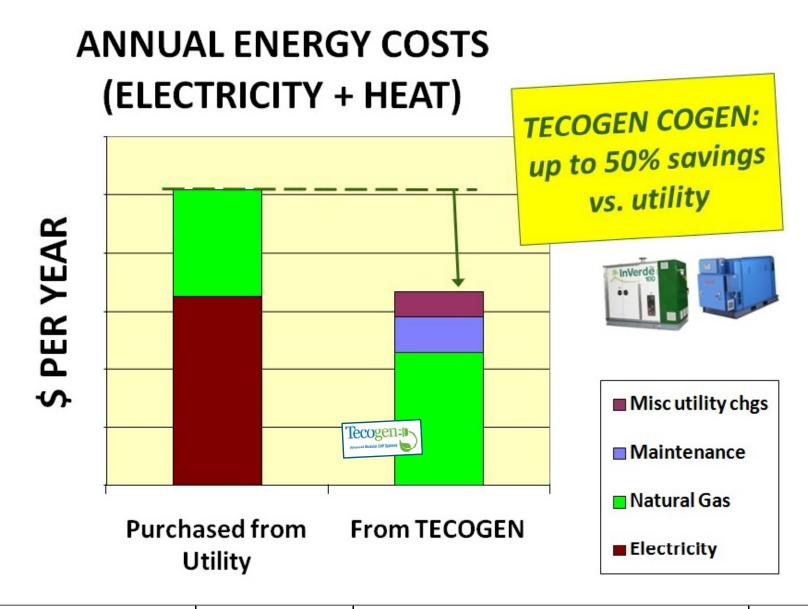


Small-CHP Technology Breakthroughs

- Recent Small-CHP technical advances:
 - California Rule 21/ UL/ ETL/ NYSIR/ CE certifications *
 - InVerde CERTS Microgrid-compatible, inverter-based module *
 - Advanced engine *
 - Ultra-low emissions *
 - * All developed with CEC support

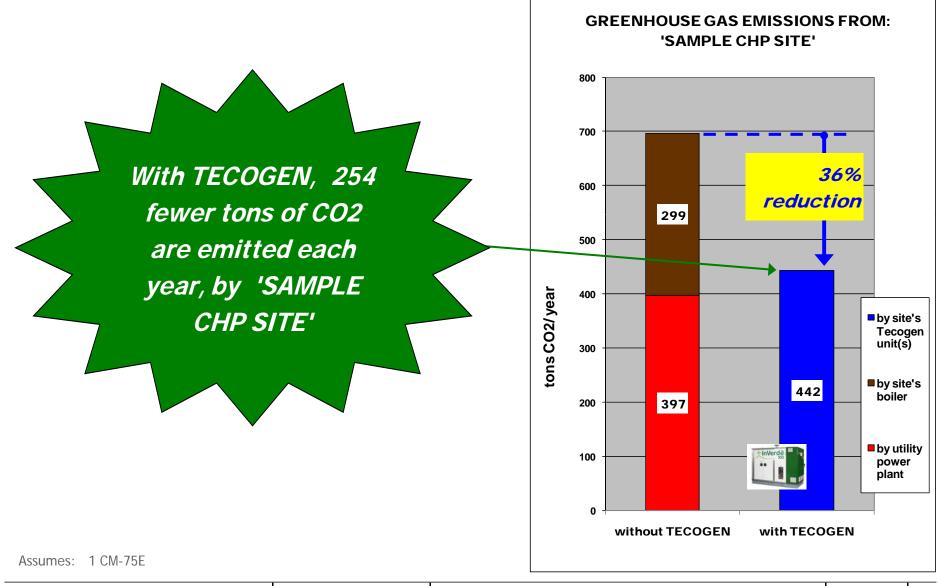






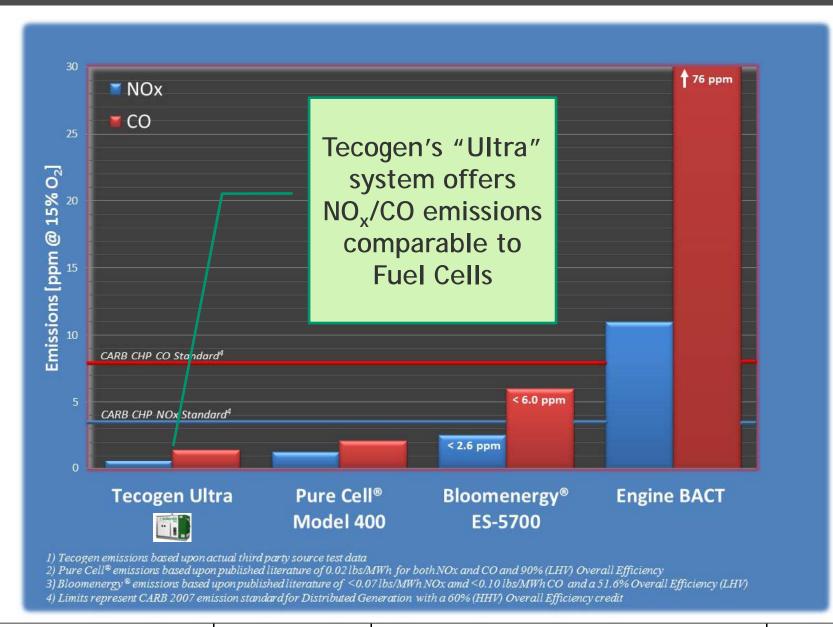


Environmental Benefits (GHG)



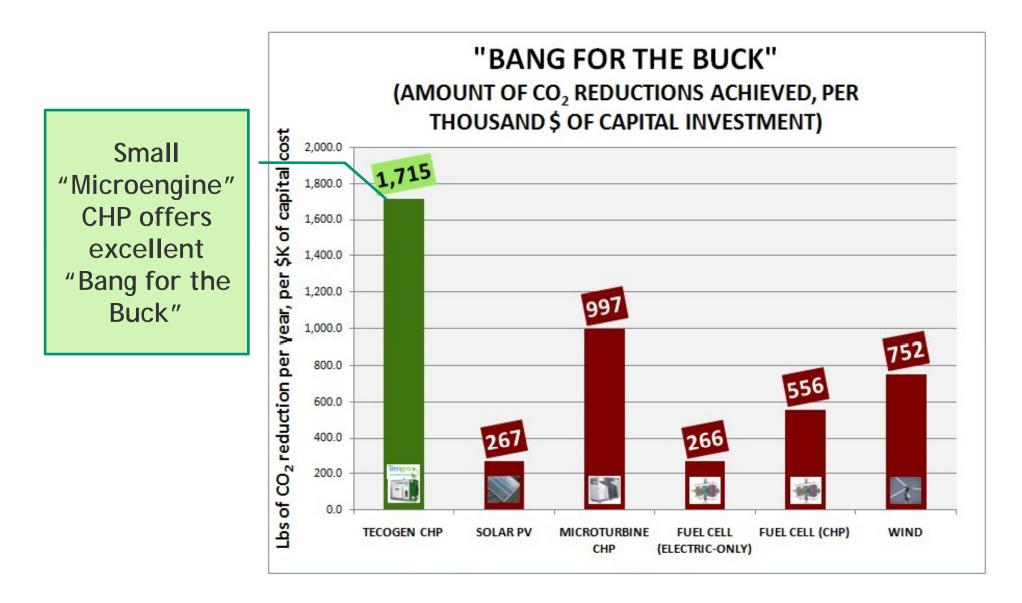


Environmental Benefits (NO_x/CO)





Cost-Effectiveness





Q1: What Motivates Decision-Makers to Install CHP?

- Economic benefits
 - Payback (<4 years required)
 - Excellent use of waste heat & electricity onsite
- Power reliability/ quality
- *Perception* of:
 - Utility & governmental support
 - Consistency with state energy policies
 - Green benefits (e.g., reduce GHG & NOx emissions)
 - Be good citizen
- Must be easy to implement



- Utility-related
 - Excessive fees killing small-CHP economics:
 - departing load charges
 - standby charges
 - interconnection charges
 - SGIP metering & monitoring costs
 Together, adding 2-3 years to payback, putting out of range of many users
 - Other tactics:
 - Complexity
 - Delays
 - CHP not eligible for Net Energy Metering (NEM)
 - No practical FIT contract yet for very small CHP systems (AB 1613)



Complexity: Sample chart for determining applicability of various utility charges to different DG technologies (about as simple as a third-world bus schedule!)

| | | IS THE TARIFF-RELATED COMPONENT BELOW APPLICABLE? | | | | | | | | | | | |
|----|--|--|--|---|---|--|--|--|---|--|---|--|---|
| # | | standby exerption PU Code 353 exemptions expire \$112311 | Physical Assurance (see note 12) | Initial supplemental and review fees (see mote 16) | \$0.005058wih - DVIR Bond Charge (8ce note 17) | | \$ 20375 G-SUR (gas - franchise fee surcharge) | (See nore 1 for decalds) - Power Charge Indifference Adjustment ¹ | (\$0.0006554WMh) Ongoing CTC Aupline 2024 (fee note hi) | (\$0.00x728x96) - expires 2012 - Energy Cost Necovery Amount ² | (8ec-\$0.014 ; Prim - \$0.01312) Public Purpose Program Charge ¹ | (80.001666kWh) Nuclear Decommissioning Charge ¹ | |
| 1 | (On-line < DWR entry into the market 2/12331 Pre-DWR DG ⁴ | Yes only if I mean PU Code 253 | Yes | Yes | No D.03.04 KNO | Yes insul meet PU Codes 215.6 and 379.8 or gas investigation customer) | Yee (exception Gib Sportson of gas and/or state facility) | 740 | Yee, unless net mellerection per PU Dode 372 tagenesitan ² | 140' | Yes, unless net invaried | Yes unissing intered | D.01-07-027 D. 03-04-030 PU Code 2827 / |
| 2 | (On line < 11/1/2010); an for authority to const. <8/09/01 ontine=21103 -3,000089 CO cap not applicable Grand fathered Customer Generation DG ⁴ | Yes only if it means PU Code 353 | Yes | Yes | Ves 0.00.04 D00 effective 40.00 | Yes (must meet PU Codes 215.6 and 379.8 or gas investigation customer) | Yes (exception Gibls potential states and/or state facility) | 740 | Yee, unless not melecolor, per PU Code 372 toppendue* | No' | Yes, unless net meaned | Yes, unless net metered | D.01-07-027 D. 03-04-030 PU Cusiv 2827 |
| 3 | Net makined grejects \$1.NW_Except BUGGAS UPLESTER Continuer Generation(CO) | Yes - no surset date for standby exemption | RW. | hin rozepi reprogramming los | No | Yes (must meet PU Codes 215.6 and 275.8 or gas interminister currently | Yes (exception GEE potenticipes and/or state facility) | 740 | Yes except for first NWV only first cogen - all exemption operation PO Code DV2 cogeneration 2008 | No' | No7 | No7 | D.01-07-027 05-04-050 PU Code 2827 9 |
| | BIO GAS DIGESTER CG Net national gregiesis \$1.30% | Yes - to surset date for standby exemption | EW. | hin except reprogramming lee | No | Yes (must meet PU Codes 215.6 and 279.8 or gas intermission customer) | Yes (exception GEC potenticliges and/or state facility) | 740 | Yes exception first HWV only first cogonical exemption organic PO Code 3/2 cogeneration ^{4,0,4} | No' | Yee PU Codes 301-333 and 305 | Yee PU Code 379 | D.01-07-027 05-04-090 PU Code 2827 9 |
| £ | Non-Net meterod projects \$1.30W | Yes - no surset date for standby exemption | EW. | hio escept reprogramming lee | No | Yes (must meet PU Codes 213.6 and 279.8 or gas transmission customer) | Yes (exception GEE potential gas and/or state facility) | 740 | Yes exception first NAV only finat cogon - all exempting cogen - POTCode 3/2 cogeneration ^{4,0,4} | No' | Yes | Yes | D(01-07-027 @CB-T) 03-04-050 PU Code 280 |
| e | Solar projects under 5 WV ELIGIBLE for net melering, SGP or CEC Incention. () Incident(6 | Ves (standby agreement required for fuel cellible projects see Notes #13 and 14) and installed < 12/3103 | Yes | No charge up to 55,000 app lea waived but reprogramming lea may apply | No for the first 1 XW7 only | Yes (must meet PU Codes 215.6 and 279.8 or gas transmission customer) | Yes (PU Code 379.8 - 45% mim cite of. For C-EC portion of gas and/or state facility) | 740 | Yes exception first NAV only finat cogon - all exempting cogen - PO Code 3/2 cogeneration ^{4 Aut} | No' | Yes | Yes | D 01 07 027 PU Cade 353 PU Cade 2527 01 030 PU Cade 378 I PU Cade 1011 AD 11 |
| , | Solar projects under 5 IOV NOT ELIGIBLE for net malaring, SGP or CEC Incentives () Interfere(). | Yes if < 5 MV and installed < 12/31/08 | Yes | No charge up to 55,000 app lea waived but reprogramming lea may apply | Yes | Yes (must meet PU Codes 213.6 and 379.8 or gas transmission customer) | Yee (exception GEE portion of ges and/or state facility) | 74a | The, unless: coper per PU Code 372 coperation ⁴²¹⁰ | No' | Yes | Yes | D 01 07 027; PU Cade 353 . PU Cade 3527 Di 000 |
| | Ellogas digestentuelarind cell projecte under 5 MW ELICELE for net meteringNEWEN explicit 1201/06 (No DA for NENEC) SOF or CEC incentives (chacken(6 | Ves (standby apreend it required for fuel cellible projects see Notes #13 and 14) and installed < 12/31/08 | Yes | Yes | No for the first 1 //// only | Yes (must meet PU Codes 215.6 and 379.8 or gas transmission customer) | Yes (PU Code 379.8 - 45% mim clot of For C-EC portion of gas and/or state facility) | 740 | Yes exception first NW only finat cogon - all exempted cogen - PUTCode 3/2 cogeneration ^{4 Aut} | No' | Yes | Yes | D 01 07 027 PU Code 353 PU Code 2527 04 030 PU Code 378.1 PU Code 1341 AD 11 |
| , | Bages of children in the set of projects which it is the test of the set of t | Ves identity assessment reacted in fact cellible projects see Notes #13 and 14) and installed < 12/31/08 | Yes | Yes | Yes | 179 Il or gas transmission currenter) | ancier state facility) | 140' | copression ^{ent} | No' | Yes | Yes | 04 000 PU Code 379 8 PU Code 5041 AD 4 |
| 10 | Cotegory 1 ⁴ (Crean under 1 WW) most SNALL IC enginee fail in here | Yes-must be installed + 12/51/08 | Ties | Yes | Ko' | Yes (must meet PU Codes 215.6 and 279.8 or gas investigation current) | Yes (exception G-E-Sportaer of gas another state facility) | 140' | Yes exception first NMV only. First cogen - all exemption organ - PU Crale SV2 cogeneration ^{4,4,4} | No' | Yes, unless nel metered or C DG free exempt for GPPP | Yes, unless red instance | 0.01-07-027 03-04-030 |
| 11 | Category 2 ⁹ (Ultra- Clean, over 1 MA and also non-natimetered) | Yes if less 5100 and installed = 12/31/38 | Yes | Yes | Yes | Yes (must meet PU Codes 215.6 and 279.8 or gas transmission customer) | Nex (exception Giblis portion of geal and/or state facility) | 140' | Tre, unless: coper per PU Code 372 copenend ce ⁴²⁰ | No' | Yes, unless & ES then exempt for GPPP | Yes | D 01 07 027: PU Cade 353 - PU Cade 2027 Di Di0 |
| 12 | Category 3 ¹⁹ (Other DG meeting BACT) | Yes if masts PJ Code 553 | Yes | Yas | Yes | Yee (must meet PU Codes 215.6 and 279.8 or gas (weenission customer) | Yes (exception G-EC portion of gas and/or state facility) | No' | Yee, unless, coper per PU Code 372 coperand co ⁴⁴⁵ | No' | Ves, unless & E.S. Inen exempt for GPPP | Yes | 0.01-07-027 03-04-030 |
| 13 | Condinuous DA with CG - DA thru period 2/101 and 9/20/21 | Yes if masts PJ Code 353 | Yes | Yes | No | Yes imust meet PU Codes 215.6 and 279.8 or gas (weenission customer) | Yee (exception G-EC portion of gas and/or state facility) | No' | Yee, unless, coper per PU Code 372 coperend co ⁴⁰⁵ | No' | Ves, unless & E.G. Inen exempt for GPPP | Yes | PU Codex 381-383, 385 and 579, D. 044024 |
| 14 | D4 switching to CG - a non-continuous customer switching to CC | Yes if meets PU Code 553 | Yes | Yas | Ves unless exempled from category above (2, 05, 02,051 | Yes imust meet PU Codes 215.6 and 279.8 or gas investigation customer) | Yee (exception G-EC portion of gas and/or state facility) | Yes for past charges not for prospective charges as long as cap not mater!. 9/2101 | Yee, unless, coper per PU Code 372 coperand co ^{rd th} | Yes for past charges not for prospective charges as long as cap not met all 9(210) | Ves, unless & E.G. Inen exempt for GPPP | Yes | PU Godes 301 -353; 365 and 379; 0: 04 02 0 D 05 02 051 |
| 15 | Continuous DA - sustainers that remains ti on DA both helper and Max 0/101 including CARE and redical DA | The distance of the line SNS | Yest | Ten | - Nor | Yes enust next PU Codes 210.0 and 170.8 or gas transmission customers | Yee (except for G F G potten right and/or state (bulky) | 162 | Yos, unless, cogen per PU Code \$72 cogeneration ⁴⁴⁷ | Yes (0.04-02-012) | Yes, uncss G-E0 mon exemptific GPPP | Yes | PU Codes 381 -353; 386 and 379; 0. 04-02-0 D 02-11-022 |
| 15 | DA taking bundled service on or before \$112001 | Yes If meets PU Code 358 | Yes | Yes | No Resolution 2013 | The critical meet PU Codes 212 G and 129-1 or give internet to containing | New rewearpt for G-EC portion of gea entities state for ity) | No Resolution 3213 | Tex, adies: coper per PU Code 272 Lugene di te ^{rate} | Yee. (10.04.027.052) | Weig and the ST ST Street excerning free Galifier | Yus | PD Cades 301, 305; 308 are: 379; 31, 64, 65, 6 D 55, 11, 629; Reent 3013 |
| 17 | DiesekNon-BACT DG ¹¹ | No. | THO | 140 |))ex | 184 | 104 | 10 | 194 | Tax. | Tex | 744 | 0.01-07-022 03-04-030 |



- Government (Legislature/ CPUC/ CEC)
 - CEC inverter certification process no longer available for CHP
 - Bureaucratic Catch 22
 - Something the CEC can fix today



Unequal CPUC treatment for various DG technologies:

| CPUC Regulation: | Renewables (Solar PV, Wind, Hydro) | Onsite Biogas- Fired Fuel Cells | Onsite Biogas- Fired Turbines, or IC Engines | Natural Gas-Firec Fuel Cells (including "electric only" fuel cells, and "directed" biogas fuel cells, which actually burr natural gas) | Ultra-Efficient, Clean Natural Gas-Fired CHP (Microengines, Microturbines, & Large Engines/ Turbines, all with Full Heat Recovery) | Other Energy Efficiency (causing identical kW/ kWh reductions; lighting, etc) |
|--|---|------------------------------------|--|---|--|--|
| Exempt from having to pay stand-by charges | YES | YES | YES | YES | NO | YES |
| Exempt from having to pay all "departing load" charges (aka "exit fees") | YES | YES | YES | YES | NO | YES |
| Eligible for "Net Energy Metering (NEM)" | YES | YES | YES | YES | NO | (n/a) |
| Eligible for a practical Feed In Tariff (FIT) | YES | YES | YES | YES | NO | (n/a) |
| Utility interconnection application & study fees waived | YES | YES | YES | YES | NO | YES |
| "Net Generation Output Meter" requirement waived | YES | YES | YES | YES | NO | YES |
| Eligible to receive utility incentives | YES | YES | YES | YES | YES (but much lower incentive level) | YES |



Regulations are giving improper market signals:

| | DG Technology 1 | DG Technology 2 |
|------------------------------------|-----------------|-----------------|
| Characteris <u>tics</u> | | |
| System size (kW) | 100 | 100 |
| Fuel input | Natural gas | Natural gas |
| NOx emissions | ultra low | ultra low |
| Overall energy efficiency (HHV) | ~49% | 85% |
| % GHG emissions reductions | 0-10% | 25-35% |
| Module cost | \$700,000 | \$130,000 |
| | | |
| Regulatory Treatment | | |
| SGIP incentive (\$/kW) | \$2,250 | \$500 |
| Federal tax credit | 30% | 0-10% |
| Eligible for NEM | Yes | No |
| Exempt from departing load charges | Yes | No |
| Exempt from standby charge | Yes | No |
| Practical FIT available | Yes | No |

oversubsidized

undersubsidized



- Government (Legislature/CPUC/CEC)
 - Unlevel playing field has been created
 - Arbitrary and prescriptive biases for certain DG technologies has become the norm
 - "Picking winners" not working
 - "Special interest"-driven prescriptive approach conflicts with rational energy policymaking
 - Instead: Who has the best lobbyist?
 - Focus on regulators, rather than facilities and efficiency engineering



- Government (Legislature/CPUC/CEC)
 - Yields a lower benefit ("bang for the buck"), in terms of the GHG reductions and project economics achieved.
 - Causes inefficient deployment of taxpayer & ratepayer resources.
 - Creates market distortions, confusion, unfairness
 - Excessively complex rules deter end-users from adopting CHP technology.



Q3: How can state support active CHP development?

- Recommendations:
 - Phase out non-bypassable departing load charges
 - Phase out standby charges (esp. if already paying demand charge on same kW)
 - Extend Net Energy Metering (NEM) to CHP
 - Extend SGIP (also make it simpler and more sensible)
 - Restore a simpler and more level playing field for all technologies.
 - More uniform regulatory treatment.
 - Legislators and regulators should resist the temptation to "pick winners" among various technologies. Let technologies' inherent characteristics, efficiencies, and advantages play out instead.
 - Yields best "bang for the buck" for customers, ratepayers, GHG.

