# State Experiences with Financial Incentives to Promote Clean Distributed Energy: Greenhouse Gas Reductions with CHP


**Tom Bourgeois**

**Chris Young**

**Northeast Combined Heat and Power Application Center**

**Pace Energy Project**

# Promoting Clean DE:
## Do We Consider Incentive Design?

- A broad range of mechanisms is available for promoting clean DE
- Each mechanism offers the grantor (the state) and the grantee (the end-user) some advantages, and some <u>dis</u>advantages
- Grantor wants: maximum clean MWh produced, demand reduced, emissions avoided, per $ granted
- Grantee wants: more $'s, received sooner, less transaction costs (M&V, contracting)

# Rationale for Incentives

**Economic Benefits**

- Competitiveness, productivity, growth
- Create new jobs in a state or region
- Promote/nurture a new industry ("infant industry")

**Environmental Benefits**

- Reduce criteria pollutant emissions (NOx, SOx, Hg, PM)
- Reduce greenhouse gases (primarily $CO_2$ and $CH_4$)

**System Benefits**

- Reduced reliance on imported fossil fuels
- Reducing grid congestion
- Lowering peak demands & impacts on prices
- Improving the diversity of energy supplies in a region

**Security**

- National security arguments
- Reliability during outages/disasters ("safe havens")

# Inventory of Incentives:
## all are different, and work differently

- ✓ **Installed Capacity Payments** (fixed $/kW of nameplate)
- ✓ **Project Grants** (XX% of project costs, capped at $X Million)
- ✓ **Peer Reviewed Project Grants** (NYSERDA PONs)
- ✓ **Production Tax Credits** (PTC)
- ✓ **Investment Tax Credits** (ITC)
- ✓ **Low-Interest Loan Programs**
- ✓ **Net Metering** (Payments for "excess" production)
- ✓ **Renewable Portfolio Standards** (RPS) / Utility Purchase Obligations
- ✓ **Special Gas Purchase Rates** (Fuel Discount)
- ✓ **Locational Payments** or **Time Specific Payments**
- ✓ **Carbon Cap and Trade** (RGGI, CA)
- ✓ **Carbon Tax** (price on emitted carbon increases spark spread)

# Mapping Goals/Objectives to Technologies

| Goal \ Technology | PV | Wind | Fuel Cells (bio) | CHP (bio) | Fuel Cells (gas) | CHP (gas) |
|---|---|---|---|---|---|---|
| Energy | * | ** | *** | *** | *** | *** |
| Capacity | * | * | *** | *** | *** | *** |
| Reduced criteria pollutants (NOx, SOx, Hg, PM) | *** | *** | ** | ** | ** | ** |
| Reduced GHG emissions | *** | *** | *** | *** | ** | ** |
| Economic (jobs) | ? | * | ? | ? | ? | * |
| Economic (new industry) | *** | ** | * | -- | * | -- |
| Economic (growth/ competitiveness/) | --- | - | -- | ? | - | * |
| Economic (energy cost benefits) | --- | -- | -- | * | -- | ** |
| Reliability | - | - | *** | * | *** | * |
| Energy supply diversity | *** | *** | *** | *** | - | - |
| Reduced reliance on imported fossil fuels | *** | *** | *** | *** | * | * |
| Security / disaster response | ? | ? | *** | *** | ** | ** |

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# Objectives of Energy Incentives
## Observations

No one technology / application meets all of the stated objectives

Some objectives are conflicting at least in the short-to-medium term
(e.g. supporting an "infant industry…., AND providing lower prices)

Some objectives are complimentary
(e.g. greater efficiency…., AND $CO_2$ reductions)

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# What CHP Is and Is NOT

## CHP is NOT…

- Renewable (typically)
- Infant Industry
- Zero Emissions

## CHP IS…..

- GHG mitigation measure (typically)
- Air emissions reduction measure (typically)
- Cost-effective relative to alternatives

# CHP and Climate Policy

CHP can be an important component of a short-to-medium term GHG mitigation plan.

Studies have shown that CHP may be more cost-effective for achieving GHG reductions than certain renewable technologies (e.g., Solar PV, Smaller-Scale Wind).

But, CHP is often the "step-child" of the energy policy world. Neither at home in Energy Efficiency (EE) legislation nor in Renewable Energy (RE) policy measures.

# Wringing GHG Reductions from CHP

* Need a good thermal application, that the system makes use of for many hours per year (i.e., the overall efficiency must be in the exemplary range)
* Renewable-fueled CHP obtained the overwhelming share of GHG reductions (among engines/turbines) in a detailed impact analysis.

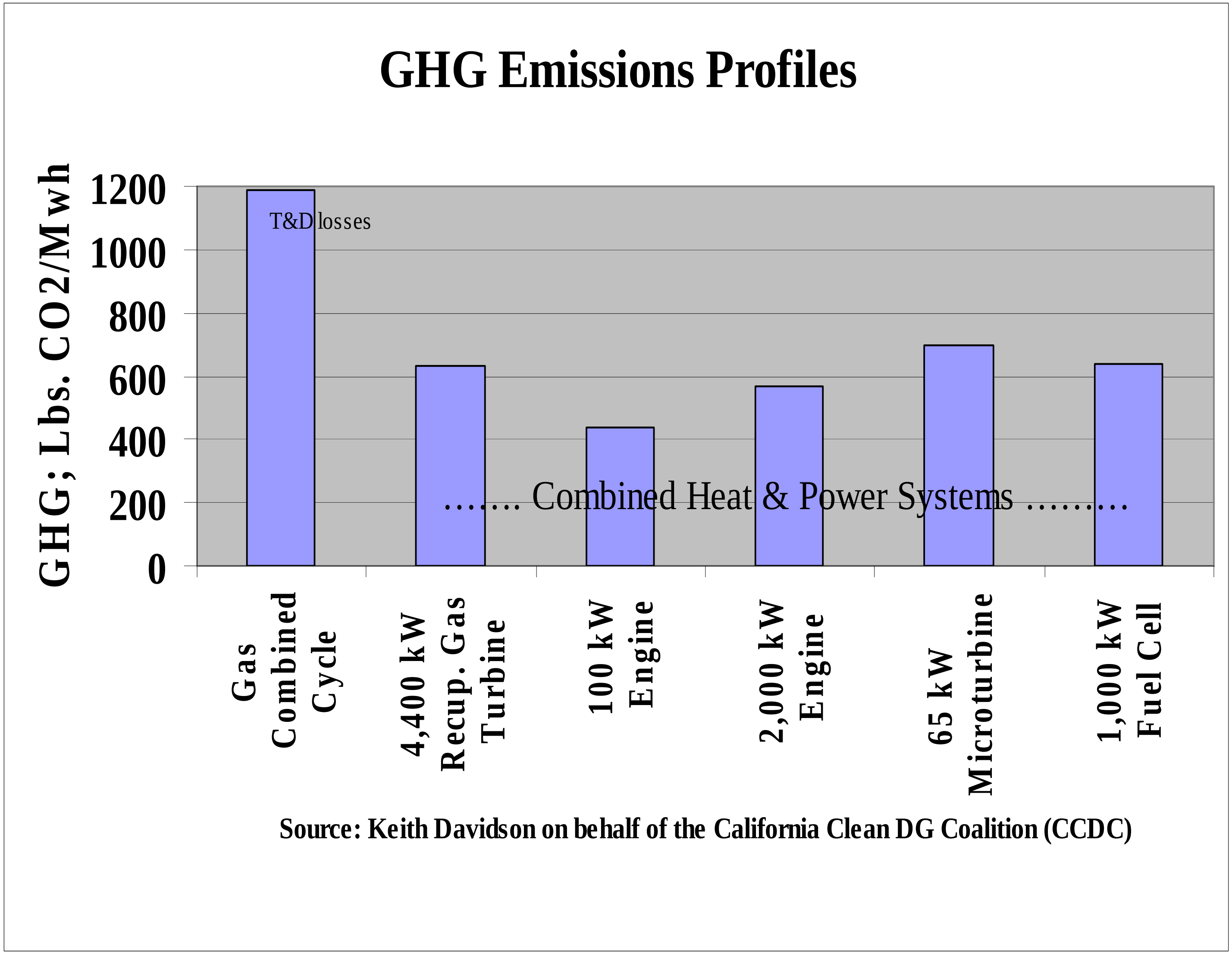
Policy Implications:

- *Incremental rewards for biomass based applications*
- *Incremental rewards for top decile of efficiency*
- *Map out what you want to achieve!*

# Possible Sub-Matrix of Goals for CHP

| CHP Attributes | Maximize GHG Mitigation |
|---|---|
| Renewable Fuel | *** |
| Efficiency % | ** |
| Long Run Times | ** |
| Displace Goal/Dirty Fuel | * |
| Run During Peak/Dirty Hours | * |

# GHG Emissions: CHP vs. NGCC



# Impact Evaluation Results (CA SGIP)

| | Incentive ($Mil) | Capacity (MW) | Production (MWh) | Incentive $'s per MWh | Incentive $'s per kW |
|---|---|---|---|---|---|
| Renewables: | | | | | |
| PV | $ 203.7 | 55.6 | 65,915 | $ 3,089 | $ 3,842 |
| Wind | $ 3.1 | 1.65 | 2,038 | $ 1,521 | $ 1,879 |
| FC's: Renewable | $ 3.4 | 0.75 | 2,637 | $ 1,289 | $ 4,533 |
| Fuel Cells: Non-Renewable | $ 4.5 | 1.80 | 11,164 | $ 358 | $ 2,222 |
| Engines/Micro-turbines: Renewable & Non-Renew | $ 59.0 | 95.4 | 399,495 | $ 145 | $ 543 |
| TOTAL | $ 273.7 | 155.2 | 481,250 | | |

**Source** SGIP 2005 Impact Evaluation, ITRON Corporation (www.socalgas.com/business/selfgen/docs2007/2007_SGIP_FifthYearImpactEvaluation_2005.pdf

# GHG Reductions per Incentive $

| | GHG Reduction Potential (tons of $CO_2$ per MWh) | Incentive $'s per MWh | Incentive $'s per Ton Reduction |
|---|---|---|---|
| **Solar PV** | 0.60 | $3,089 | $5,148 |
| **Wind** | 0.61 | $1,521 | $2,493 |
| **Engines/Microturbines (Renewable & Non)** | 0.11 | $ 145 | $1,318 |

**Source** SGIP 2005 Impact Evaluation, ITRON Corporation (www.socalgas.com/business/selfgen/docs2007/2007_SGIP_FifthYearImpactEvaluation_2005.pdf

# Four State Comparison

**California**

- Small Generator Incentive Program (no longer funds CHP)

**Connecticut**

- 2006 incentives for DG/CHP aimed at easing capacity shortfall
- EE/CHP procurement requirement
- Existing renewables programs hard to compare w/ CHP (lack data)

**New Jersey**

- Tiered incentives for desired technology types, including CHP
- RPS and other market-based incentives

**New York**

- NYSERDA programs demonstrate innovative applications and sponsor new technologies
- New RPS, slow easing of interconnection etc., standby, residential net metering only

# Four State Comparison

## Similarities

- High energy prices
- Political will for energy incentives
- RPS states
- Deregulated

## Differences

- Goals of incentive programs
- Attitudes toward combustion technologies
- History with CHP
- Climate
- Industrial mix

# SGIP / ITRON Methodology

| Technology | Annual Cap. Factor | Reduction Factor (Tons/MWh) |
|---|---|---|
| PV | **16%** | **0.61** |
| Wind | **15%** | **0.60** |
| FC's: Renewable | 65% | **1.59** |
| FC's: Non Renewable | 95% | **0.19** |
| Engines/Microturbines (all) | **42%** | **0.11** |

**Developed a GHG assessment methodology for CA:**

- Figures based on CA experience and market – displacement of dispatchable resources (hydro and nuclear non-dispatchable)
- We estimated fuel cell capacity factors from very small sample graph

# Four State Results:
# $ Incentive/ton

| | PV | Wind | Bio | CHP |
|---|---|---|---|---|
| CA | $3,089 | $1,521 | | $145 |
| CT | | | | $1,067 |
| NJ | $5,192 | $559 | $2,722 | $1,016 |
| NY | $5,793 | $5,793 | | $1,045 |

**Using a consistent spreadsheet methodology for comparison:**

- For NY and CT, reductions per ton $CO_2$ from CHP cost 10% - 20% of the next most cost-effective measure
- In NJ, the wind program appears much better in this calculation

# Alternate Methodology:
## CHP $ Incentive/Ton GHG

| State | CHP $/Ton |
|---|---|
| CA | $346 |
| CT | $196 |
| NJ | $186 |
| NY | $192 |

**Using computed factor of .6 tons/MWh of CHP production (which used assumptions shown in the following slide).**

# CHP Impact Assumptions

- 5 MW natural gas system
  - Net efficiency = 28%
  - Power to heat = 0.68
  - Thermal = steam/hot water
  - 8200 hours/year
- National Average Fossil Central Station Generation – eGrid (2000)
  - Heat rate = 10,462 Btu/kWh
  - 1,950 lbs $CO_2$/MWh
  - 7% T&D losses

# Conclusions

**Data and Research**—further effort is needed on:

(a) investigation of measurable GHG impact of energy incentives;

(b) consistent reporting across states; and

(c) evidence to map goals with objectives.

**Policy Formulation:**

Policy makers should carefully weigh multiple objectives when designing policies and incentives in the energy markets.

**Climate Policy:**

The most popular new technologies may not offer greatest GHG mitigation value.

# Northeast Application Center Contacts


Tom Bourgeois

NAC Co-Director for Education and Outreach

(914) 422-4013 (voice)

tbourgeois@law.pace.edu

Beka Kosanovic

NAC Co-Director for Technical Assistance

(413) 545-0684 (voice)

kosanovi@ecs.umass.edu


*http://www.northeastchp.org/nac/*