Online Webinar
September 7, 2011

CHP Feasibility Study : Processes & Tools

For Audio
Dial : 866 740 1260
Enter : 3637922

Krishnan Umamaheswar, LEED, CEM, CDSM, DGCP
US DOE Gulf Coast Clean Energy Application Center

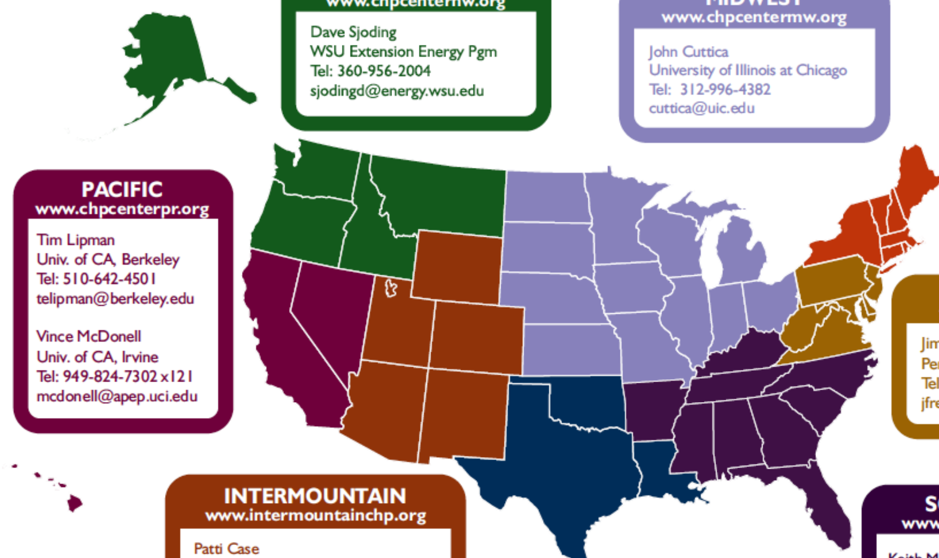
U.S. Department of Energy
Gulf Coast Clean Energy Application Center

Before we begin…

- Presentation
  - Emailed to all attendees within 24 hours
  - Posted to www.gulfcoastcleanenergy.org
- Questions
  - Real Time
- Continuing Education Units (CEU)
  - Upon request

Clean Energy Application Centers

DOE Clean Energy Application Center Locations, Contacts, and Web Sites



NORTHWEST
www.chpcenternw.org
Dave Sjoding
WSU Extension Energy Pgm
Tel: 360-956-2004
sjodingd@energy.wsu.edu

MIDWEST
www.chpcentermw.org
John Cuttica
University of Illinois at Chicago
Tel: 312-996-4382
cuttica@uic.edu

NORTHEAST
www.northeastchp.org
Tom Bourgeois
Pace Energy and Climate Center
Tel: 914-422-4013
tbourgeois@law.pace.edu

Beka Kosanovic
University of Massachusetts Amherst
Tel: 413-545-0684
kosanovi@ecs.umass.edu

PACIFIC
www.chpcenterpr.org
Tim Lipman
Univ. of CA, Berkeley
Tel: 510-642-4501
telipman@berkeley.edu

Vince McDonell
Univ. of CA, Irvine
Tel: 949-824-7302 x121
mcdonell@apep.uci.edu

MID-ATLANTIC
www.chpcenterma.org
Jim Freihaut
Pennsylvania State University
Tel: 814-863-0083
jfreihaut@engr.psu.edu

INTERMOUNTAIN
www.intermountainchp.org
Patti Case
etc Group
Tel: 801-278-1927 x 3
plcase@etcgrp.com

Thomas Broderick
Southwest Energy Efficiency Project
Tel: 928-527-8036
tbroderick@swenergy.org

GULF COAST
www.gulfcoastchp.org
Dan Bullock
Houston Advanced
Research Center
Tel: 281-364 6087
dbullock@harc.edu

SOUTHEAST
www.chpcenterse.org
Keith McAllister
North Carolina State University
Tel: 919-515-3933
keith_mcallister@ncsu.edu

Pedro Mago
Mississippi State University
Tel: 662-325-6602
mago@me.msstate.edu

DOE Clean Energy Application Center Program Contacts

Ted Bronson
DOE Clean Energy Application Center Coordinator
Power Equipment Associates
Phone: 630-248-8778
E-mail: tlbronsonpea@aol.com

Bob Gemmer
Industrial Technologies Program (ITP)
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
Phone: 202-586-5885
E-mail: Bob.Gemmer@ee.doe.gov

Patti Garland
Distributed Energy/
CHP Program Manager
Oak Ridge National Laboratory
Phone: 202-586-3753
E-mail: Patricia.Garland@ee.doe.gov

Primary Activities – Gulf Coast Application Center

- Promote CHP, Waste Heat Recovery & District Energy through
  - Education & Outreach
    - Website
    - Newsletters
    - Webinars
    - Workshops
  - Policy Initiatives
    - Educate legislators
    - Comment on dockets/rulings
    - Support TXCHPI (active CHP industry advocates in the region)
  - Project Support
    - Free or low cost CHP feasibility studies
    - Case Studies/Project profiles
    - Answer technical questions
    - Connect end-users to equipment manufacturers
    - Facilitate tours to CHP installations for prospective adopters
    - Manufacturer neutral and unbiased service

CHP Project Development Cycle

- Stage 1: Qualification
- Stage 2: Feasibility Study
- Stage 3: Investment Grade Audit : Design & Development
- Stage 4: Procurement
- Stage 5: Operations & Maintenance

Qualification - Basics

- Goal
  - Determine whether CHP is worth considering
- Timeframe
  - 30 minutes
- Conducted by
  - Building Owner/Staff
- Links
  - http://www.epa.gov/chp/project-development/qualifier_form.html

Qualification - Questionnaire

- Are you concerned about the impact of current or future energy costs on your business?
- Is there a substantial financial impact to your business if the power goes out?
- Does your facility operate for more than 5000 hours/ year?
- Do you have thermal loads throughout the year (steam, hot water, chilled water, hot air, etc.)?
- Does your facility have an existing central plant?
- Do you anticipate a facility expansion or major renovation within the next 3-5 years?
- Have you already implemented energy efficiency measures and still have high energy costs?
- Are you interested in reducing your facility's impact on the environment?

CHP Feasibility Studies : GC RAC Approach

- Screening Analysis
  - Establish if a site has the POTENTIAL to be a good candidate for CHP

- Detailed Analysis
  - Establish if CHP is VIABLE technically and financially

GC RAC website – CHP feasibility studies, project profiles, software tools : http://www.gulfcoastcleanenergy.org/ProjectSupport/FeasibilityStudies/tabid/1997/Default.aspx

U.S. Department of Energy
Gulf Coast Clean Energy Application Center

Screening Analysis

- Based on monthly electricity consumption, gas use and related expenditures
  - Industry rules of thumb
  - Rough Capital Costs
  - Determination of Simple payback

Screening Analysis : Tools

- **MAC Assessor Spreadsheet**
  Download
  This tool developed by the Midwest Clean Energy Application Center is an easy to use screening tool which takes monthly electric and gas bills, certain other basic CHP system inputs to provide an approximate screening analysis with regards to CHP feasibility.

- **Cogen Ready Reckoner**
  http://www1.eere.energy.gov/industry/distributedenergy/pdfs/cogen_manual.pdf
  Cogen Ready Reckoner is a program to assist users with a "first pass" technical and financial analysis of cogeneration at their site. The program is a 'Ready Reckoner' intended for quick preliminary evaluations. The Cogeneration Ready Reckoner is distributed by the Australian Commonwealth Department of Industry, Tourism and Resources in association with the Australian EcoGeneration Association (to become the Australian Business Council for Sustainable Energy). The Ready Reckoner conducts a simple technical and financial analysis of a cogeneration opportunity. Should the cogeneration opportunity appear attractive on this evaluation, then it is recommended that the user conduct more detailed analyses, or engage suitable advisers to consider the project evaluation to the extent necessary to commit funds or to entertain alternative.

- **Southeast RAC Screening Tool**
  http://www.chpcenterse.org/chp_screening_tool/CHP_Screening_Tool.htm
  A simple, basic, first pass online screening tool developed by the Southeast Clean Energy Application Center. Requested inputs include electricity and gas unit costs, capital costs and generator efficiency. Outputs include Simple payback and spark spread.

- **GC RAC Screening Tool**

GC RAC Screening Analysis Tool : Basics

- Inputs (Required & Optional)
  - Electricity Consumption (kWh)
  - Electricity Costs ($)
  - Gas Consumption (MMBtu)
  - Gas Costs ($)
  - Hours of Operation

- Outputs (Tables, Graphs & Charts)
  - Option 1: Highest Efficiency Option (lowest waste)
  - Option 2: Trigeneration
  - Option 3: Highest Reliability
  - Option 4: Custom Option (User can chose prime-mover)

GC RAC Screening Analysis Tool : Additional Details

- Open source : MS Excel Spreadsheet. Downloadable –
- Contains list of prime-movers (will be updated from time-to time)
- Inputs – Required & Optional (caters to degree of users familiarity vis-à-vis CHP)
- Automatic sizing of prime-mover manufacturer, model number and capacity based on thermal load.
- Accounts for part load performance, temperature effects on turbine output
- Capital costs & other performance metrics, based on research and subsequent regression analysis

GC RAC Screening Tool Demonstration

- <u>Case Studies</u>
  - Hospital
  - Office Building
  - Industrial User
  - Hotel

Detailed Analysis : Basics

- Walkthrough site-assessment
- Utility rate structure analysis
- Hour by hour simulation using DOE software
- Calibration of baseline model to actual utility bills
- Generation of "Alternate / What if?" scenarios
- Sensitivity analysis
- Use financial models to generate internal rate of return (IRR)
- Minimal cost to owner ($3,000-$10,000)

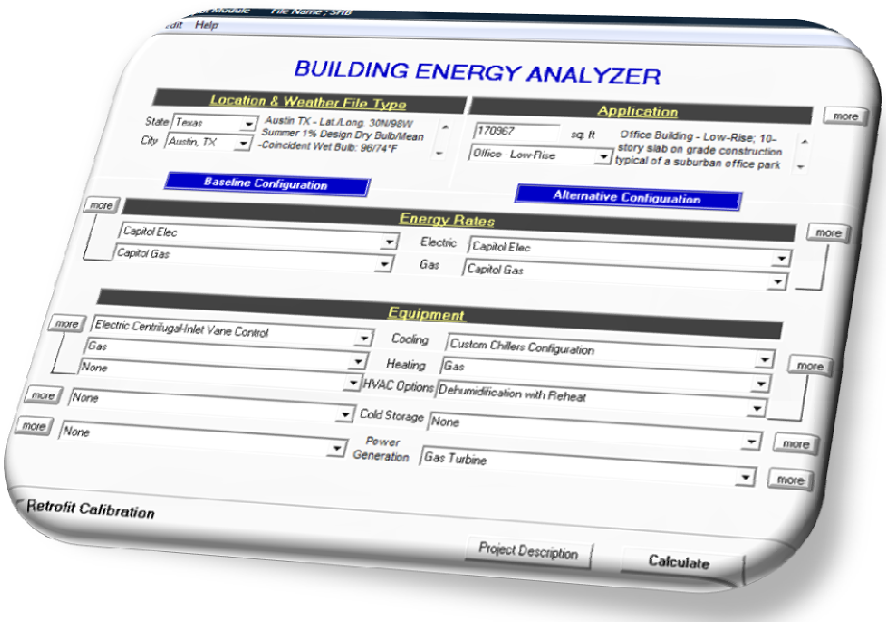
Detailed Analysis : Case Study

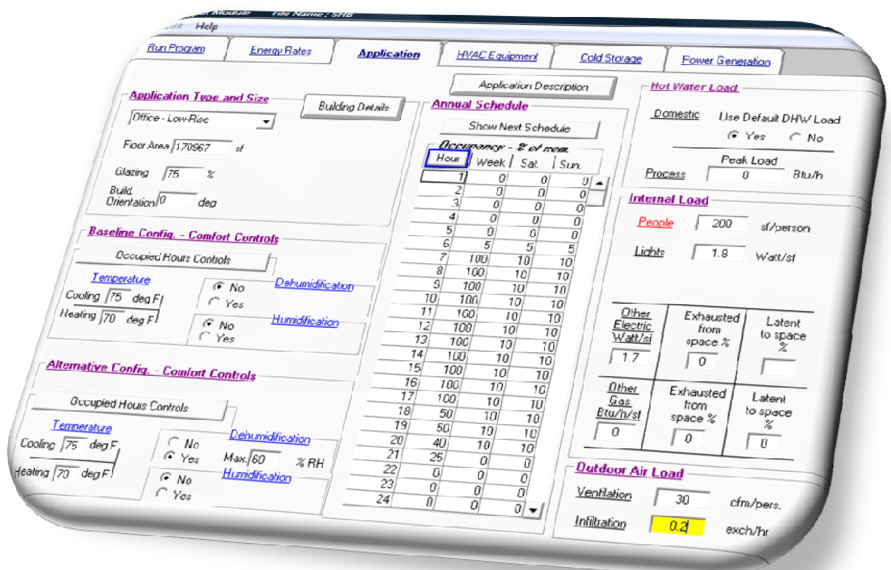
- Texas Capital Complex : Austin, Texas
  - 25 Buildings
  - 4.8 million existing sq ft + 7 million potential new construction space
  - Mostly office space; new construction : mixed use
  - Existing Central Plant (some aging chillers & boilers)
    - Chilled water and steam distribution
- GC RAC conducted detailed feasibility study
  - Phase 1 : Highest Efficiency Option
  - Phase 2 : Highest Reliability Option

Step 1 : Data Collection

Bldg ID	BLDG Name	Address	Gross Area (Ft2)
ARC	Lorenzo De Zavala Archives & Library	1200 Brazos	111,244
CSB	Central Services Building	1711 San Jacinto	97,002
CSX	Central Services Annex	311 East 14th St.	15,070
CVC	Capitol Visitors Center	112 East 11th St.	19,458
	Capitol		360,000
	Capitol Extension		667,000
DCG	Dewitt C. Greer	125 E. 11th St.	84,039
INS	Insurance Building	1100 San Jacinto	86,029
INX	Insurance Annex	221 E. 11th St.	59,757
JER	James E. Rudder Building	1019 Brazos	77,880
JHR	John H. Reagan Building	105 West 15th Street	161,787
LBJ	Lyndon B. Johnson Building	111 E. 17th St.	299,512
PDB	Price Daniel, Sr. Building	209 West 14th St.	135,926
REJ	Robert E. Johnson Building	1501 North Congress	307,091
SCB	Supreme Court Building	201 W. 14th St.	69,253
SFA	Stephen F. Austin Building	1700 North Congress	418,103
SHB	Sam Houston Building	201 East 14th St.	170,967
TCC	Tom C. Clark Building	205 West 14th St.	101,299
THO	E. O. Thompson Building	920 Colorado	67,689
TJR	Thomas Jefferson Rusk Building.	200 E. 10th St.	99,971
WBT	William B. Travis Building	1701 North Congress	466,440
WPC	William P. Clements Building	300 West 15th St,	473,215
WPH1	William P. Hobby Building Twr. I (13 flr)	333 Guadalupe St.	229,861
WPH2	William P. Hobby Building Twr. II (5 flr)	333 Guadalupe St.	49,453
WPH3	William P. Hobby Building Twr. III (9 flr)	333 Guadalupe St.	140,058
CCE	Capitol Complex Expansion	TBD	7,100,000

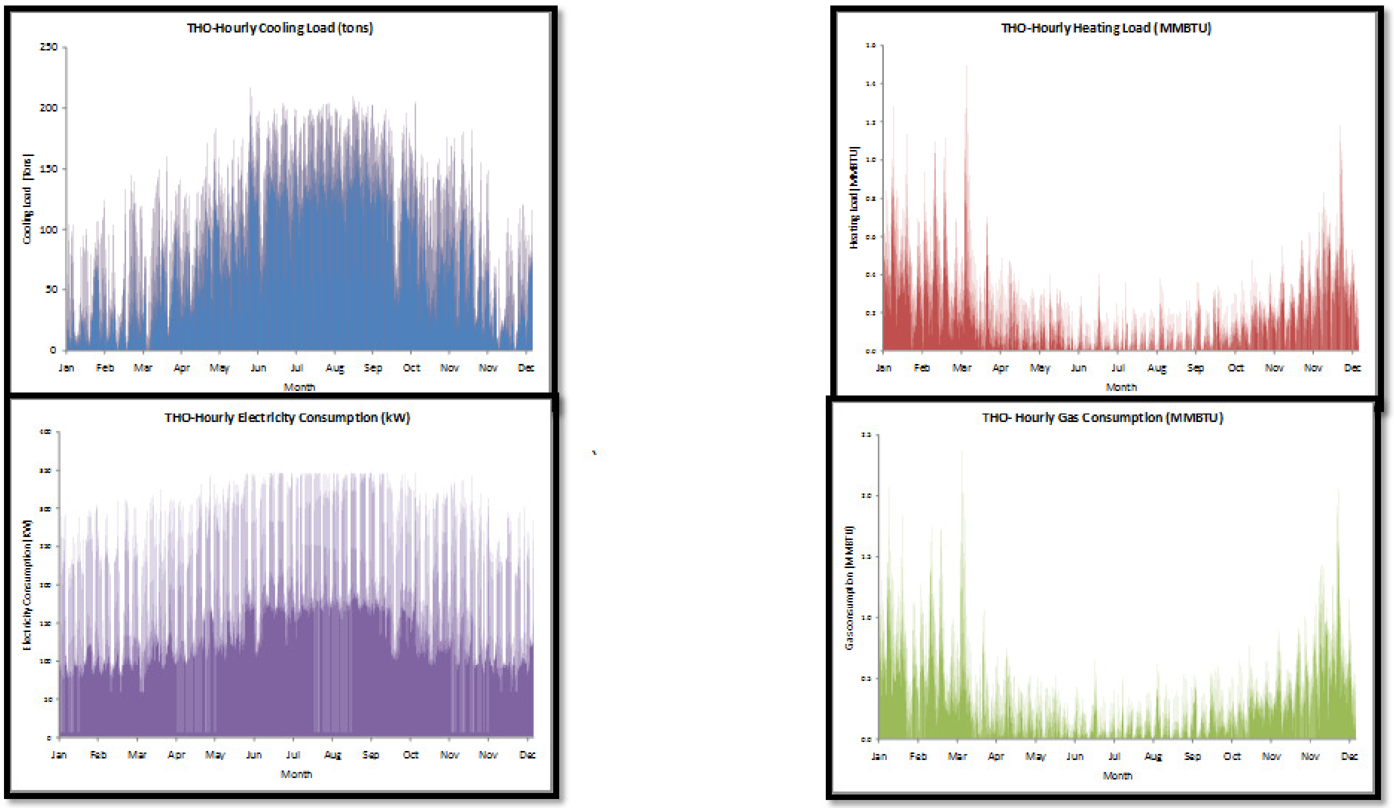
Step 2: Energy Modeling & Calibration to Utility Bills – Each building

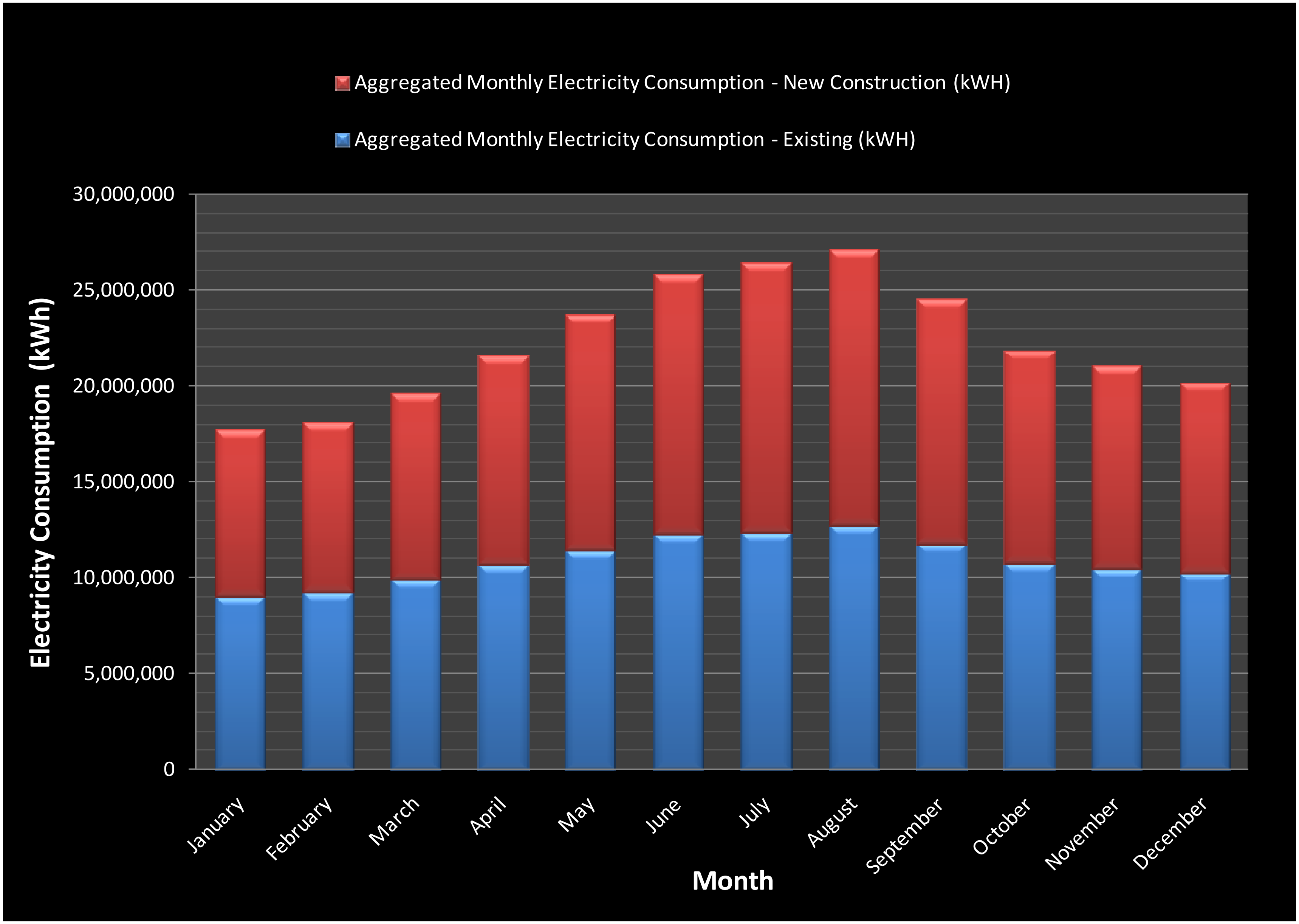


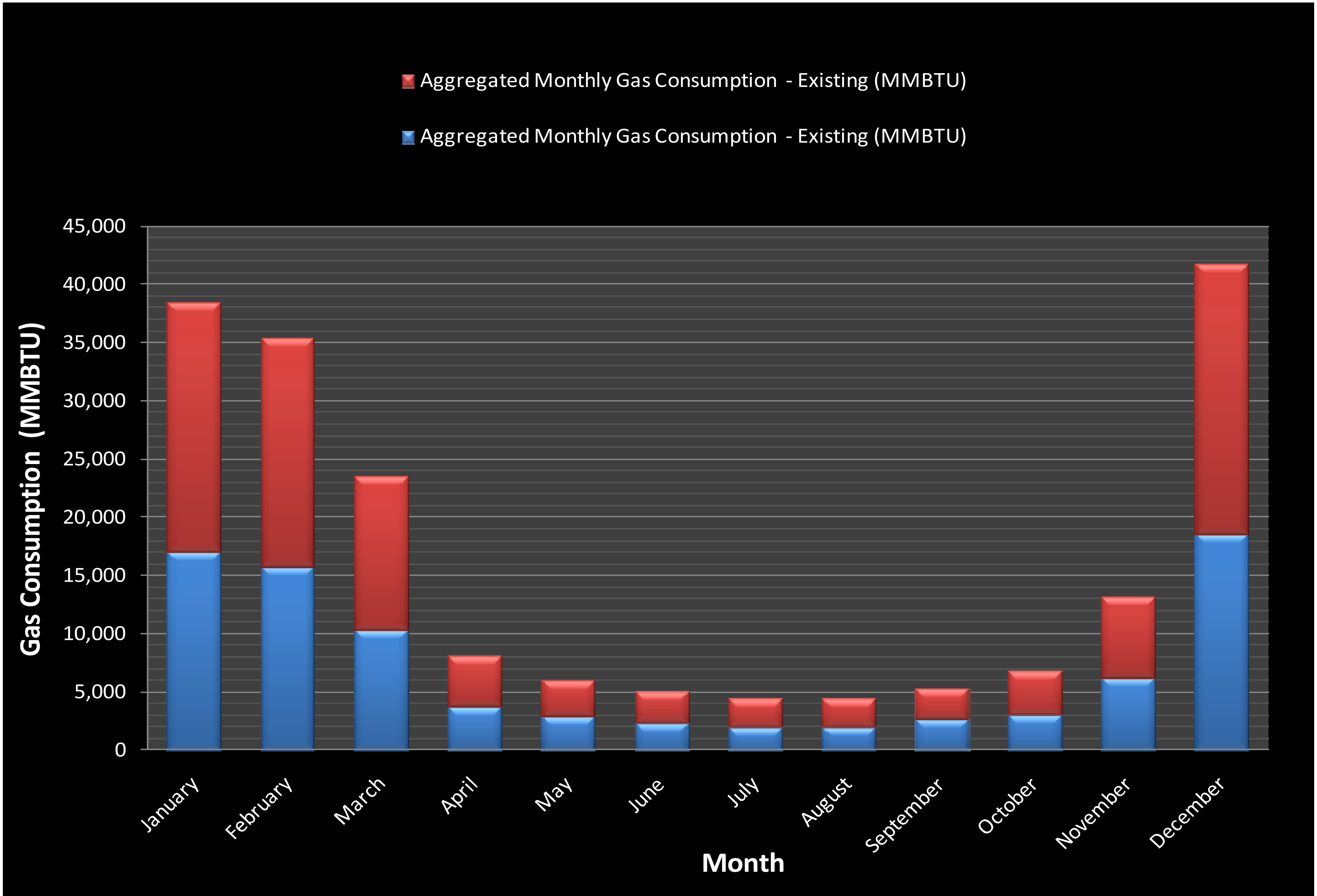


Generate hourly electric, gas, heating and chiller load profiles

Figure 42. *THO- Modeled Hourly Consumption & Loads*



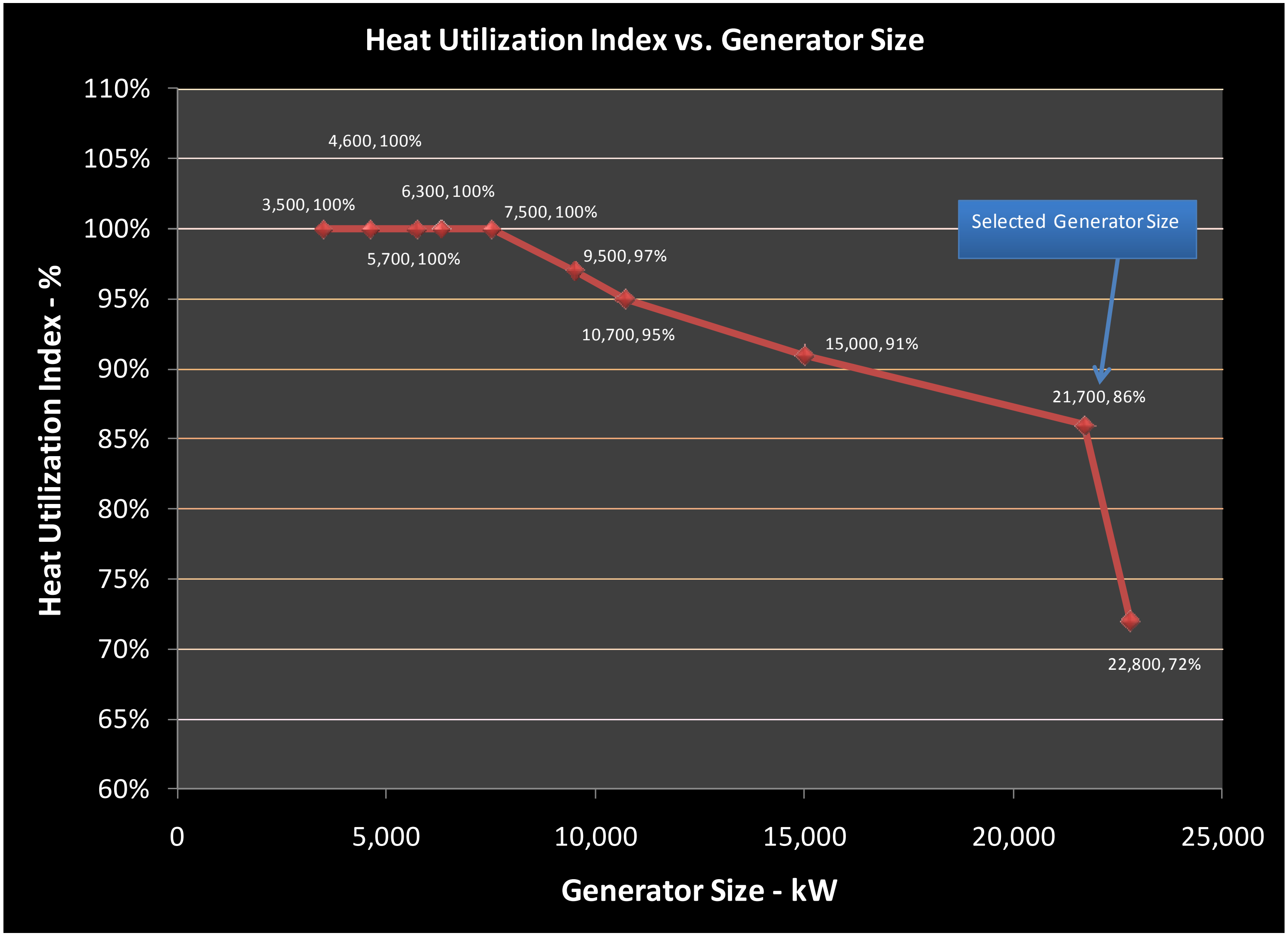

Aggregated Monthly Electricity Consumption - New Construction (kWH)
Aggregated Monthly Electricity Consumption - Existing (kWH)
Electricity Consumption (kWh)
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
January
February
March
April
May
June
July
August
September
October
November
December
Month



U.S. Department of Energy
Gulf Coast Clean Energy Application Center

CHP Detailed Analysis – Demo Spreadsheet

Turbine Selection

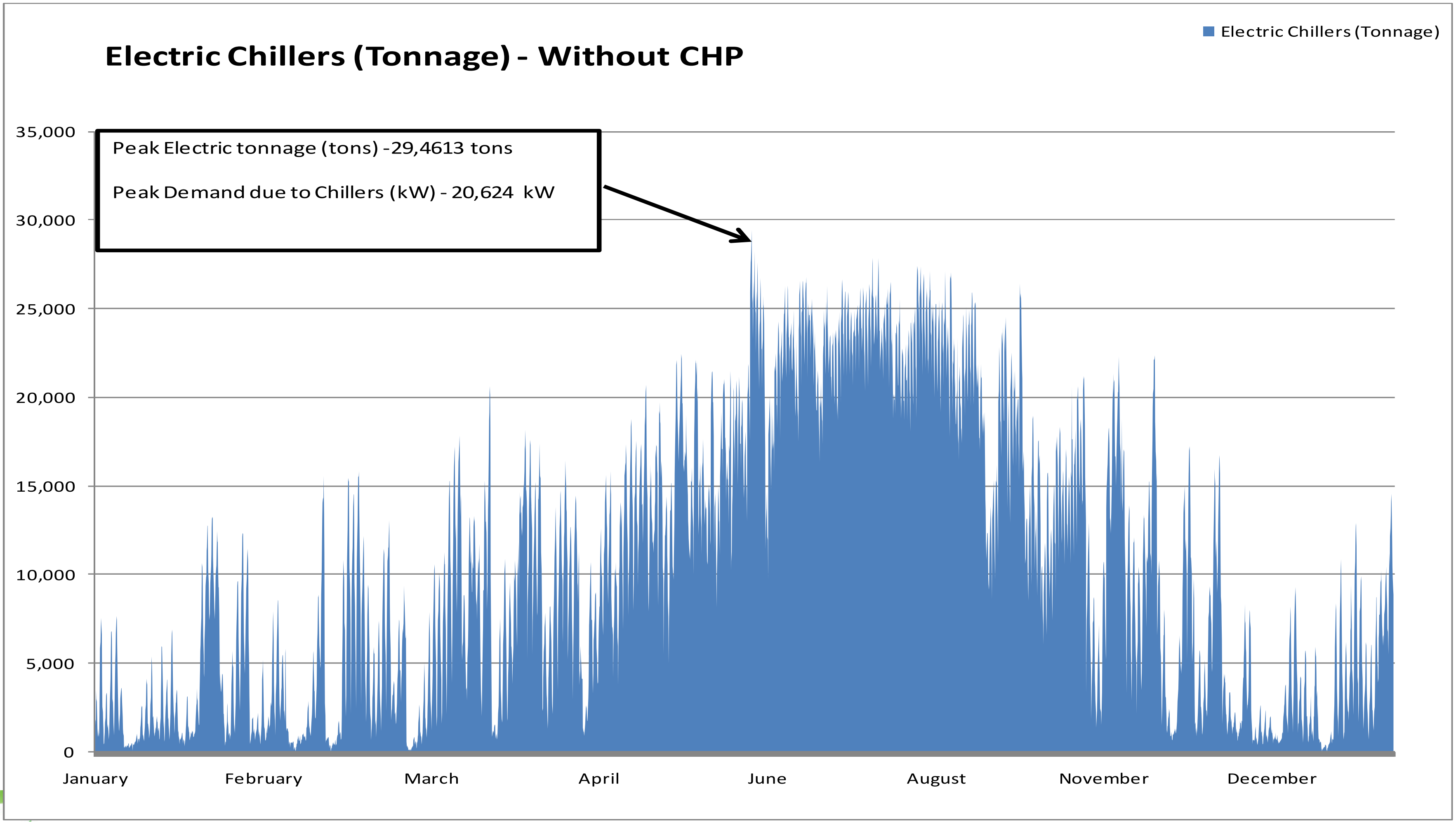


U.S. Department of Energy
Gulf Coast Clean Energy Application Center

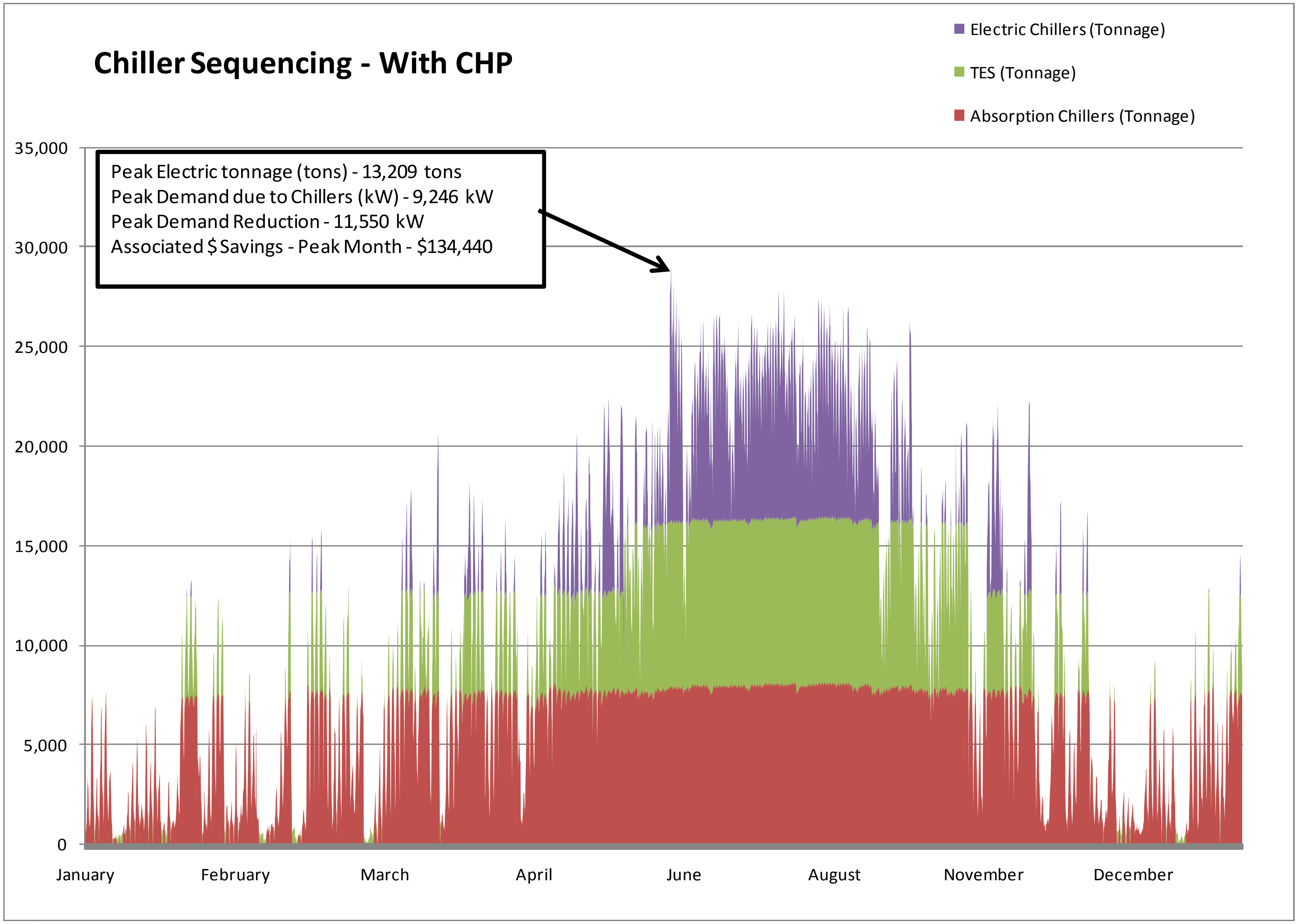
Thermal Energy Storage Selection

Sl No	Equipment	Absorption Chiller Capacity (tons)	Heat Utilization %	TANK SIZE (ton-hrs)	Conventional Approach - Energy Charges($)	CHP Plant - Energy Charges ($)	Net Savings ($)	Net Installation Costs ($)	IRR
1	1 TITAN 250	8,322	81%	0	$21,115,594	$15,960,937	$5,154,657	$20,774,049	18.3%
2	1 TITAN 250	8,322	83%	10,000	$21,115,594	$15,818,928	$5,296,666	$21,641,905	18.4%
3	1 TITAN 250	8,322	84%	25,000	$21,115,594	$15,627,501	$5,488,093	$22,693,337	18.5%
4	1 TITAN 250	8,322	85%	50,000	$21,115,594	$15,345,189	$5,770,406	$24,149,829	18.8%
5	1 TITAN 250	8,322	86%	75,000	$21,115,594	$15,083,771	$6,031,823	$25,611,181	19.0%
6	1 TITAN 250	8,322	86%	100,000	$21,115,594	$14,830,326	$6,285,268	$27,776,481	18.6%

Peak Period Electric Chiller Profile – No CHP



Peak Period Electric Chiller Profile – With CHP



Capital Costs

ITEM	QUANTITY	UNIT COST	DEFAULT COST	Capital Costs	Vendor	Costs used Analysis
Prime Mover w/Generator (kW)	21,700	1,000	$ 21,700,000	$ 9,430,000	Solar Turbines	$ 9,430,000
Heat Recovery (hp)	incl.		$ -	$ 1,708,500	Solar Turbines	$ 1,708,500
Absorption Chiller (tons)	8,322		$ 5,409,283	$ 4,479,400	Solar Turbines	$ 4,479,400
Chilled Water Tank (ton-hrs)	75,000		$ 9,900,000	$ 9,917,900	Jacobs Engineering	$ 9,917,900
Natural Gas Supply Upgrades	None		$ -			$ -
Natural Gas Compressor (hp)	50		$ -	$ 1,762,600	Solar Turbines	$ 1,762,600
Tranformer & All Related Electrical			$ -	$ 510,700	Solar Turbines	$ 510,700
Exhaust Stacks	incl.		$ -			$ -
Diverter Valve	incl.		$ -			$ -
Pipe, Valves, Fittings	incl.		$ -			$ -
SCR Emissions Reduction			$ -	$ 1,196,000	Solar Turbines	$ 1,196,000
Project Controls			$ -	$ 115,000		$ 115,000
Physical Building & Structures	10,000 ft2	$100/sq ft	$ 500,000		Estimate	$ 500,000
Project Developlment Costs			$ 3,000,000		Estimate	$ 3,000,000
Mechanical Design Engineering			$ -	$ 1,353,700		$ 1,353,700
Substation & Electrical Engineering	incl.		$ 750,000			$ 750,000
Utility Interconnection & Metering			$ -	$ 234,400	Solar Turbines	$ 234,400
Permits	Air/water/bldg		$ 100,000		Estimate	$ 100,000
Construction	incl.		$ -	$ 6,014,200	Solar Turbines	$ 6,014,200
Shipping/Rigging	estimated		$ -	$ 393,300	Solar Turbines	$ 393,300
SUBTOTAL			$ 41,359,283	$ 37,115,700		$ 41,465,700
Contingency	10%		$ 4,135,928	$ 2,566,100	Solar Turbines	$ 2,566,100
ESTIMATED PROJECT COST			$ 45,495,211	$ 39,681,800		$ 44,031,800

Avoided Costs

AVOIDED CAPITAL COSTS				
ITEM	**QUANTITY**	**Source**		**AVOIDED COST**
Electric Chillers (tons)	17,750	$400/ton	$	7,100,000
Boilers Room Turn-key (MMBtu)	142	from quote	$	1,135,000
Back up Generators (kW)	8486	Estimate	$	1,633,506
Diesel storage (39102 gal) and fuel	1	Estimate	$	597,755
Engineering	@ 30% of equip	Estimate	$	3,139,878
Construction	@ 30% of equip	Estimate	$	3,139,878
Contingency	@ 10% of total cost	Estimate	$	1,674,602
ESTIMATED AVOIDED COSTS			**$**	**18,420,619**

Internal Rate of Return Calculations

Economic Analysis	Cost Year	2010
Interest or Bond Rate	5.0%	
Marginal Tax Rate	0%	
Capital Cost (1000$)	44,032	
Avoided Capital Costs (1000$)	18,421	
Incentives (1000$)	292	
Inflation Rate	3.0%	
Natural Gas Escalation Rate	3.0%	
Depreciation Period (Straight Line)	5	Years
Project Lifetime	20	Years

Project: Texas State Capitol Complex

Scenario: Project Owned & Operated by the State of Texas

Analyst: Krishnan Umamaheswar

Date:

After Tax IRR = 19.0%

Equiv Pre-Tax IRR = 19.0%

				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Net Installed Cost of Plant (1000$)	$25,320	$26,079	$26,861																				
Utility Projections (1000$)																							
Total Electric Cost w/o CHP	$19,697			$21,556	$22,056	$22,570	$23,100	$23,646	$24,208	$24,787	$25,383	$26,488	$27,121	$27,773	$28,444	$29,135	$29,847	$30,581	$31,336	$32,114	$32,916	$34,281	$35,131
Total Electric Cost with CHP	$5,683			$6,229	$6,381	$6,537	$6,698	$6,864	$7,035	$7,211	$7,393	$7,706	$7,898	$8,097	$8,301	$8,511	$8,728	$8,951	$9,180	$9,417	$9,661	$10,050	$10,309
Total Gas Cost w/o CHP	$1,418			$1,550	$1,596	$1,644	$1,693	$1,744	$1,796	$1,850	$1,906	$1,963	$2,022	$2,083	$2,145	$2,209	$2,276	$2,344	$2,414	$2,487	$2,561	$2,638	$2,717
Total Gas Cost with CHP	$9,400			$10,272	$10,580	$10,898	$11,225	$11,561	$11,908	$12,265	$12,633	$13,012	$13,403	$13,805	$14,219	$14,646	$15,085	$15,538	$16,004	$16,484	$16,978	$17,488	$18,012
Gross Revenues for CHP Investment																							
Change in Electric Cost	1000$			$15,328	$15,675	$16,033	$16,402	$16,781	$17,173	$17,576	$17,991	$18,782	$19,223	$19,676	$20,143	$20,624	$21,120	$21,630	$22,156	$22,697	$23,255	$24,231	$24,823
Change in Gas Cost	1000$			-$8,723	-$8,984	-$9,254	-$9,531	-$9,817	-$10,112	-$10,415	-$10,728	-$11,049	-$11,381	-$11,722	-$12,074	-$12,436	-$12,809	-$13,194	-$13,589	-$13,997	-$14,417	-$14,850	-$15,295
Net Average Year Annual Savings	1000$			$6,605	$6,691	$6,779	$6,870	$6,964	$7,061	$7,160	$7,263	$7,733	$7,842	$7,954	$8,069	$8,188	$8,310	$8,436	$8,566	$8,700	$8,838	$9,382	$9,528
Operating Costs																							
Maintenance Allocation (@ $10/MWH)	1000$			$1,841	$1,896	$1,953	$2,011	$2,072	$2,134	$2,198	$2,264	$2,332	$2,402	$2,474	$2,548	$2,624	$2,703	$2,784	$2,868	$2,954	$3,042	$3,134	$3,228
Maintenance Cost of Generator System	1000$			$920	$948	$976	$4,856	$1,036	$1,067	$1,099	$1,132	$6,665	$1,201	$1,237	$1,274	$1,312	$7,727	$1,392	$1,434	$1,477	$1,521	$8,957	$16,617
Cumul. Maint. Sinking Fund Balance	1000$			$920	$1,868	$2,845	$0	$1,036	$2,103	$3,202	$4,333	$0	$1,201	$2,438	$3,712	$5,024	$0	$1,392	$2,826	$4,303	$5,824	$0	-$13,389
Annual Energy Production (MWh)	184,062																						
EBIDA	**1000$**			**$5,685**	**$5,743**	**$5,803**	**$2,015**	**$5,928**	**$5,994**	**$6,061**	**$6,131**	**$1,068**	**$6,641**	**$6,717**	**$6,795**	**$6,876**	**$584**	**$7,044**	**$7,133**	**$7,223**	**$7,317**	**$424**	**-$7,089**
Tax Implications																							
Added Income				$5,685	$5,743	$5,803	$2,015	$5,928	$5,994	$6,061	$6,131	$1,068	$6,641	$6,717	$6,795	$6,876	$584	$7,044	$7,133	$7,223	$7,317	$424	-$7,089
Interest Payments Financed Over (Years)	20			-$1,343	-$1,302	-$1,260	-$1,215	-$1,168	-$1,119	-$1,067	-$1,012	-$955	-$895	-$832	-$766	-$697	-$624	-$547	-$467	-$382	-$293	-$200	-$103
Straight Line Depreciation	5 yr			-$5,372	-$5,372	-$5,372	-$5,372	-$5,372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Change in Taxable Gross Income				-$1,031	-$932	-$829	-$4,573	-$612	$4,875	$4,995	$5,119	$113	$5,746	$5,885	$6,029	$6,179	-$40	$6,497	$6,666	$6,841	$7,023	$224	-$7,191
Taxes Owed				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Income After Taxes				**$5,685**	**$5,743**	**$5,803**	**$2,015**	**$5,928**	**$5,994**	**$6,061**	**$6,131**	**$1,068**	**$6,641**	**$6,717**	**$6,795**	**$6,876**	**$584**	**$7,044**	**$7,133**	**$7,223**	**$7,317**	**$424**	**-$7,089**
Internal Rate of Return After Taxes			**After Tax IRR=**	**18.99%**		**Equiv IRR =**	**18.99%**	**on PreTax Basis**															
In/Outflows	1000$		-$26,861	$5,685	$5,743	$5,803	$2,015	$5,928	$5,994	$6,061	$6,131	$1,068	$6,641	$6,717	$6,795	$6,876	$584	$7,044	$7,133	$7,223	$7,317	$424	-$7,089
Financing Cash Flow																							
Cost of Financing - Uniform Payments	1000$			-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155	-$2,155
Available Cash After All Loan Payments	1000$			$3,529	$3,588	$3,648	-$141	$3,773	$3,839	$3,906	$3,976	-$1,088	$4,485	$4,561	$4,640	$4,720	-$1,572	$4,889	$4,977	$5,068	$5,161	-$1,731	-$9,244
Cumul. Net Income After Loan Payments				$3,529	$7,117	$10,764	$10,623	$14,396	$18,235	$22,141	$26,116	$25,029	$29,514	$34,076	$38,716	$43,436	$41,864	$46,753	$51,730	$56,798	$61,959	$60,228	$50,984

Emissions Calculator

- Download from EPA CHP Partnership website:
  - http://www.epa.gov/chp/basic/calculator.html
- Calculates CO_2, SO_2, and NOX emissions from a user-defined CHP system
- Compares a specific CHP system to equivalent separate heat and power (SHP)
- Requires as few as 3 CHP system-specific inputs; can customize up to 31 fields
- Outputs
  - Energy Savings
  - CHP and SHP emissions
  - CHP emissions reductions and relational benefits
  - (e.g. acres of forest, emissions from cars

Emissions Calculator : contd

- CHP System Definitions and Assumptions
  - Adaptable for generation equipment: Gas turbine, recip. engine, fuel cell, microturbine, boiler/steam turbine, other
  - Fuel flexible: Natural gas, coal, oil, biomass, other
  - May utilize user-defined or default values for various system
  - characteristics (e.g. efficiency, thermal output, fuel specs, emission rates)
- Separate Heat and Power Assumptions
  - May utilize user-defined or default values for displaced thermal efficiency and emission rates
  - Displaced central station assumptions based on eGRID, customizable by NERC region, State, fuel type

Emissions Calculator - Example

Additional Detailed Analysis Tools

- BCHP
  http://eber.ed.ornl.gov/bchpsc/

  Primary use: Hourly Analysis of CHP applications in commercial building

  Cost: Free

  Version 2 of the BCHP Tool is a significant enhancement of Version 1.2, and consists of the executable program, databases for HVAC equipment, electric generators, thermal storage systems, prototypical commercial buildings, climate data, and electric and gasutility rates. The program runs DOE2.1e in the background to calculate heating, cooling, and electrical loads and the Rate Script Editor to calculate monthly and annual utility costs. The tool is structured to perform parametric analyses between a baseline building and up to 25 alternative scenarios.

- Building Energy Analyzer Pro 3.0
  http://www.interenergysoftware.com/PDF/BEAManual.pdf

  Primary use: Hourly Analysis of CHP applications in commercial buildings

  Cost: $780

  Building Energy Analyzer™ PRO 3.0 is a software tool that aids heating, ventilation, and air-conditioning (HVAC) professionals in tailoring economic analyses for several types of facilities. The program allows users to estimate critical information such as annual or monthly loads and costs associated with air-conditioning, heating, and on-site power generation for commercial buildings. Building Energy Analyzer PRO compares the performance of a wide variety of HVAC technologies, such as standard- and high-efficiency electric chillers, variable-speed electric chillers, absorption chillers, engine-driven chillers, on-site power generators, thermal storage, heat recovery, and desiccant systems. It performs quick-to-use economic analysis for the customer's utility rates, location, and building type. Additional features include: templates for 15 typical commercial building types; handles complex utility rates; weather data for 233 cities; and performs life-cycle cost analysis on building cooling, heating, and power generation (BCHP) equipment. New features in the PRO version include hourly modeling data and the Retrofit Wizard, which helps users calibrate program input for buildings considered for retrofit. Not compatible on 64 bit machines.

CHP Investment Grade Audit : Tools

GT PRO
http://www.thermoflow.com/CombinedCycle_GTP.htm
GT PRO automates the process of designing a combined cycle or gas turbine cogeneration plant. GT PRO is particularly effective for creating new designs and finding their optimal configuration and design parameters. The user inputs design criteria and assumptions and the program computes heat and mass balance, system performance, and component sizing. The scope and level of detail in GT PRO has been continuously growing since 1988, to the point that the 2008 version has over 3000 user-adjustable inputs. Most key inputs are automatically created by intelligent design procedures that help the user identify the best design with minimal time and effort, while allowing the flexibility to make any changes or adjustments. GT PRO is truly easy to use, typically requiring only a few minutes to create a new plant design. It normally computes a heat balance and simultaneously designs the required equipment in under five seconds. When run in conjunction with the optional PEACE module, the programs provide extensive engineering and cost estimation details. Trail & Lite versions available for download. Contact Thermoflow for pricing

SOAPP
http://soapp.epri.com/soapp/productframeset.htm
SOAPP (State-of-the-Art Power Plant) software for gas turbine project analysis creates unique, detailed, project-specific conceptual designs, including heat balances, equipment design, cost estimates, and pro forma. Sophisticated, embedded engineering expertise supported by comprehensive process and equipment models keeps you from getting bogged down making engineering decisions, freeing you to concentrate on only the most critical process, equipment, and design criteria.

HEATMAP© (New version to be released soon)
http://www.chpcenternw.org/NwChpDocs/HeatMapV6.x_Brochure.pdf
HEATMAP© is a WINDOWS-base software tool that aids energy planners in designing and evaluating district energy systems, including integrated Combined Heat and Power (CHP) and geothermal applications. HEATMAP© provides comprehensive computerized simulations of CHP, district heating and cooling systems, allowing users to analyze the performance of existing networks as well as model proposed systems, expansions, or upgrades. HEATMAP is temporarily unavailable while it is undergoing a major revision. It is planned that it will be available for free download in the future.

Multi Family Analysis CHP Tools

- **The HUD CHP Screening Tool**
  Developed under a collaborative effort between the U.S. Department of Housing and Urban Development and US DOE Energy as a tool to evaluate combined cooling, heating, and power in multi-family housing. Users of the HUD CHP Screening Tool can quickly calculate a theoretical payback for a system if they enter only utility rates, location, square footage and number of occupants. For an assessment based on actual consumption, users need to type in data from their monthly power and fuel bills for one consecutive 12 month period as well as some utility rate information. The program uses these data to estimate fuel use for space and water heating and power consumption for air conditioning. The utility costs and rate information are combined with correlations for costs of generator equipment, installation, and maintenance to estimate simple payback periods for a hypothetical CHP system relative to the non-CHP system reflected in the utility data. Sites with low estimated simple payback periods are encouraged to look more seriously into CHP for both its energy savings and cost savings opportunities. Sites with high simple payback periods can save the time and effort of examining CHP in detail with assurances that they are not missing a great opportunity.

- **Detailed Analysis Tool**
  Developed in collaboration between U.S. Department of Housing and Urban Development & ORNL. The MF CHP Level 2 Analysis Tool is structured to perform parametric analyses between a baseline building, typically a conventional building without a CHP system, and up to 25 alternative scenarios with varying selections for building mechanical systems and operating schedules. Current version Beta version has only standard (or blended) single utility rate for electricity ($/kWh), and Natural Gas ($/Therm). Users are asked to input the rate directly. If user needs to do the calculation based on complex utility rates (e.g., peak demand, block charge, etc.), the hourly or monthly energy use can be generated from the tool, and the utility cost can be calculated outside of the toolkit using spreadsheet, etc.

Both Tools can be dowloaded → http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/library/energy

Supplementary Tools

- **RELCOST Financial - Economic Calculator**
  http://www.chpcenternw.org/ResourcesSoftwareLinks/Software.aspx
  Cost: Free
  The RELCOST Financial model, a Microsoft Excel spreadsheet template, is used for evaluating the financial viability of energy projects. It can be used to evaluate a variety of factors key to project success, such as the minimum power sales or carbon offset price, the optimum mix of equity and capital to attract investors, or sensitivity to incentives. Three methods of evaluating financial performance are provided by RELCOST: life cycle cost analysis, proforma statements, and financial ratios.

  Proforma financial statements provided are the Income Statement, Cash Flow Statement, Balance Sheet, and Sources/Uses of Funds Statement for each project year in the 20-year analysis period. Flexible user inputs include capital costs for construction, funding (equity, grants, and loans), operating costs (purchased fuels, labor, materials/expendables, etc.), taxes and fees (depreciation, tax credits, franchise costs, tax rates, etc.), cost escalation factors, income from energy, power and co-product sales, and income from sales of carbon offsets, renewable energy credits and renewable energy production incentives. Use of financial ratios and other financial performance indicators enable the RELCOST user to evaluate project financial outcomes under various model scenarios. These model scenarios are displayed on a Financial Scorecard in a stop-light chart (Red-Yellow-Green) for quick assessment. The ability to rapidly conduct "What If" evaluations using sensitivity factors on key project inputs enables the user to determine those factors that represent the greatest amount of risk to the project, obtain guidance on key points of negotiation, identify break-even values, and examine alternative scenarios.

- **RETScreen: Financial & Emissions Analysis**
  http://www.retscreen.net/ang/home.php
  Cost: Free
  The RETScreen Clean Energy Project Analysis Software is a unique decision support tool developed with the contribution of numerous experts from government, industry, and academia. The software, provided free-of-charge, can be used worldwide to evaluate the energy production and savings, costs, emission reductions, financial viability and risk for various types of Renewable-energy and Energy-efficient Technologies (RETs). The software (available in multiple languages) also includes product, project, hydrology and climate databases, a detailed user manual, and a case study based college/university-level training course, including an engineering e-textbook.

CHP2011

COMBINED HEAT AND POWER
CONFERENCE & TRADE SHOW

October 17-19, 2011 • Westin Galleria Hotel • Houston, Texas

- **<u>Conference & Trade Show dedicated to Cogeneration, Trigeneration & Waste Heat Recovery</u>**
  - CHP Technical Workshops
  - Plenary Sessions
  - Breakout Sessions
  - Expo Hall
  - Site Tours

- **<u>Ways to Participate</u>**
  - Register
  - Present
  - Exhibit
  - Sponsor

Conference Website – www.chpcon2011.com