VOCGEN Technology

White Paper

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Volatile organic compounds (VOC) originate from various solvents and fuels generated in industrial processes. There are thousands of VOC species and each require a specific temperature and residence time sufficient to destruct VOCs and to prevent the creation of products of incomplete combustion (PICS), which can pose dangerous health and environmental effects. The Siemens 7.9MW SGT-300 Gas Turbine VOC solution is an emerging new stationary industrial gas turbine technology featuring advanced combustor designs that enable the gas turbine engine to ingest volatile organic compounds (VOC) in the form of vapors and gases and thermally oxidize these hydrocarbons to the end products carbon dioxide and water. Waste VOC emissions are captured, conveyed, and ingested into the air intake of the gas turbine. The VOC is utilized in the gas turbine combustion chamber as a supplemental fuel in addition to the natural gas pilot fuel that is directly injected into the combustor to fuel the operation of the engine.

Now that America and the world is determined to conserve valuable energy reserves, reduce air pollution and climate change gasses via energy efficiency, high-Btu value solvent and fuel (VOC) emissions are an opportunity fuel for industry. This is because VOCs have high heat value and because VOCs can now be utilized by industrial gas turbines incorporating advanced combustor designs. Therefore, VOCs can be sensibly used in the generation of electricity and valuable waste heat onsite. This technology solves a pollution control issue; conserves energy and reduces GHG via recycling; it replaces legacy VOC abatement equipment and the associated life cycle costs; and it promises to be a catalyst for long-term investment in onsite combined heat and power for industry. Therefore, a transformational technology advances the architecture of the integrated plant environment.

Combined heat and power systems result in energy conservation, efficiency, reductions of greenhouse gases, and reliable and uninterruptable power and steam for industrial facilities when connected to an interactive grid; and CHP answers the call for Homeland Energy Security. The benefits of energy conservation and reductions of greenhouse gases are social benefits not included in break-even analysis when considering contributions of revenue vs. total fixed cost of a VOCGEN CHP System.

The United States Department Of Energy and the United States Environmental Protection Agency has determined that combined heat and power (CHP) powered by clean burning natural gas is a best available long-term strategic plan for American industry based on energy efficiency.

Because combined heat and power systems comprising gas turbines are capital intensive, to date, combined heat and power have found limited applications with the exception of large-scale downtown heating districts, and university, medical and military institutions. In the United States, Con Edison distributes 30 billion pounds of 350 F/180 C steam each year through its seven-(7) cogeneration plants to 100,000 buildings in Manhattan, which is the largest steam district in the world. The peak delivery is 10 million pounds per hour (corresponding to approx. 2.5 GW). This steam distribution system is the reason for the steaming manholes often seen in New York based movies (*Reuters: Research and Markets*). Government or "public" funds and tax incentives have been applied as a means to create workable project financing solutions for investors, lending institutions and the end user/owner. Large-scale industrial users of energy like wood, pulp and paper mills and mining operations will justify and build onsite combined heat and power systems, but it is not entirely common. Past breakthrough applications, featuring smaller-scale systems include publicly funded landfill and municipal digester gas; convention and conference centers, hotels, casinos and biomass are hot pursuits. The financial viability of commercial projects typically depends on government subsidies and incentives, stable electricity and natural gas prices and recently "guaranteed savings" by developers, however these are commercial applications as opposed to industrial manufacturing, petrochemical and/or synthetic organic chemical manufacturing, which is the focus of VOCGEN CHP Technology. Industrial applications are small-scale CHP in the range of < 50MW.

Regardless of the fact that we have a new technology and a well-defined niche market, it does not guarantee that our plan or the government's plan for combined heat and power will be implemented as widely as needed. As of now, the economy is in a recession, credit is not flowing and investors are apprehensive, but we must look into the future and understand that the economy may not change for the better unless we change it.

Combined heat and power has not been widely deployed in the past for several primary reasons (*not a comprehensive list*)

1. Electricity and natural gas prices must exceed certain price thresholds to justify the capital investment and the difference between purchased electricity and purchased natural gas the "spark spread," must be sufficient to realize a return on investment period acceptable to investors and industrial operators and owners.
2. Throughout the period of electrical deregulation, electric power monopolies have resisted combined heat and power by offering low rates for electrical power to industry and they charge tariffs and other standby charges needed for demand response to maintain generation assets in case a combined heat and power system fails and there is a sudden demand for power.
3. Electricity and natural gas prices have been "volatile" in that prices move up and down and this makes it difficult to predict and guarantee that a combined heat and power installation will be able to achieve the "savings" needed to pay back the capital investment according to contract.
4. Standard grid interconnect switchgear has just recently been developed thanks to changing standards, new legislation and policies. This has helped the States to model the changes they needed to standardize new switchgear technology to build the new "smart grid."
5. The Federal Government has led the way to promote out-put based environmental regulations and some States are modeling from that example.

Our proposed twenty-year plan involves replacing approximately 100,000 boilers, chillers, pollution control thermal oxidizers, flares and other combustion and thermally activated devices that are utilized at manufacturing, petrochemical and synthetic organic manufacturing facilities; including bulk oil, gasoline, ethanol and biogas at loading and unloading facilities in truck, train, and shipping terminals. There are approximately 100 industrial categories subject to the Clean Air Act that are major sources of VOC emissions. These industries have emission sources from operations such as paint and coatings, plastics, semi-conductor, pharmaceutical manufacturing, etc. A comprehensive list of these industries can be found on our web site at www.vocgen.com.

Economics are the key to the implementation of new energy and environmental technologies and businesses. We have witnessed the recent surge of investment in renewable clean energy alternative fuels and technologies. We have also seen many investors pull back from their optimism and investments in renewables after witnessing the actual cash flows and balance sheet results from these popular clean energy projects and businesses. A good energy idea in our economy must demonstrate compelling economics to justify investment. From the big picture, investing in new technology without real savings is just trading dollars. It may keep the economy going, but that is short-term thinking that has contributed to the existing issues we face with energy today. What is needed is real wealth generation from "true cost savings and long-term projects that create jobs." I believe, as many do, that widely deploying combined heat and power in industry can create jobs, real wealth and a very positive change for American industry.

We must wisely put into practice long-term sustainable planning and projects using energy efficient equipment and systems; projects that we can put into operation now to eliminate energy-intensive combustion technologies. The leaders in combined heat and power including State agencies and associations are correct in their approach and thinking about combined heat and power and they are on target to deploy combined heat and power. I urge investors to get involved in financing combined heat and power projects because "efficiency" means savings and that translates into long-term projects, long-term profitability,

competitiveness, and therefore CHP investments can mean a great deal to the American economy in the future.

Combined heat and power is well understood and practiced. The technology typically consists of off-the-shelf system designs together with pre-tested, pre-certified and pre-packaged equipment designed for rapid deployment once project development details including risk and feasibility assessments, permitting and contracts are in place.

For VOC gas turbine combined heat and power technology, the compelling economics are not just highly efficient energy generation and greenhouse gas reductions, but VOC abatement. On the face of it, it sounds like a very nice emerging waste to energy technology, but it significantly represents better economics. That is because it can also eliminate the life cycle costs of legacy boilers, chillers, flares and thermal oxidizers. What we have then is a new economic model for air pollution controls. It is a wealth-generation model created by increasing income and decreasing spending; where payback periods can be less than 1-2 years, it produces excellent internal rates of return and excellent savings for large-scale industrial end users. No other air pollution control or CHP technology have claim to this economic model.

Preliminary data suggests there may be over 25,000 industrial facilities in North America that might be able to take advantage of this alternative technology. If 60 percent of these facilities adopt the technology by 2025, the primary energy savings might exceed 1.25 quads of energy. This is equivalent to the petroleum production that might be provided by opening the Alaska National Wildlife Refuge[1].

We have projected that 20 years from initial commercialization, the conversion to industrial combined heat and power technology throughout American industry could contribute an estimated $3.5 trillion USD or more of wealth to the country including jobs, tax base, environmental and health benefits and the value of a decentralized grid and grid security.

I am certain that most people understand that biogas, geothermal and solar (including wind and wave) may never be able to widely power all of industry, and nuclear power does not seem to be an all-encompassing option with uranium supplies low and the overwhelming environmental concern for its use.

As fossil fuels reach peak use rates and oil and gas reserves decline around the world, nations may covet their fuel supplies and we might find the global energy situation to be a little unfriendly. If this happens, our concern here in America will be the production of our own energy, the creation of sustainable manufacturing, and the overall transformation of our future economy.

Environment & Power Systems International provides project development services as listed in our Statement of Services and represents equipment and systems built and installed in turn key projects by Siemens. Siemens provides a 100% equipment performance guarantee for their VOC CHP projects.

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1 This estimate is derived from calculations by Laitner (2004) and compared to ANWR production potential found in Koomey et al. (2003).