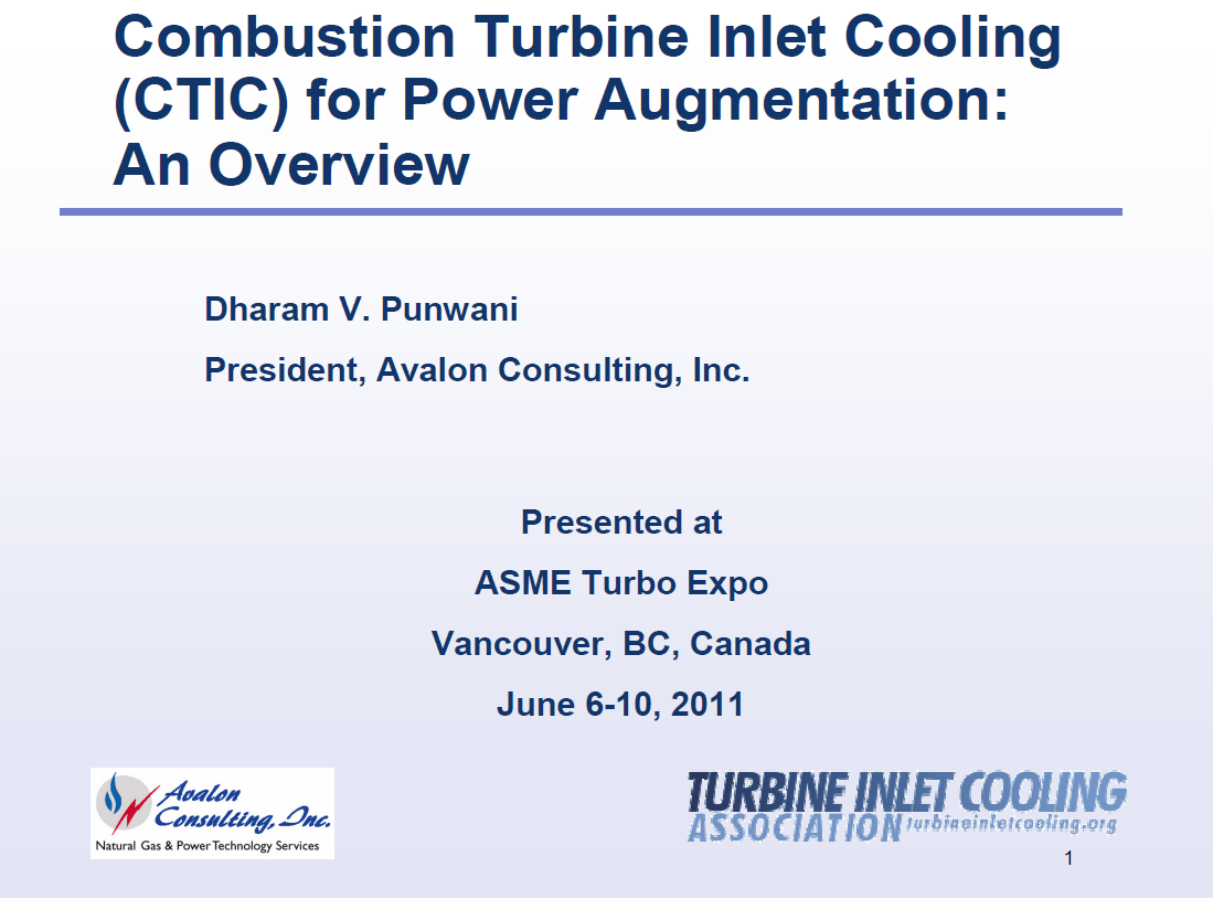
Power Augmentation Route Map and Summary

Gas Turbine Air Treatment Decision Guide

Power augmentation options

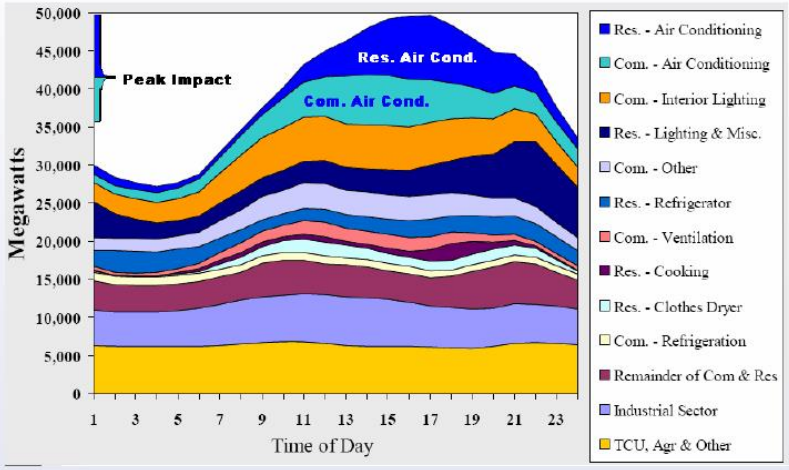
Wetted media
- *Fogging*
- *Mechanical refrigeration*
- *Absorption cooling*
- *Wet compression*
- *Indirect evaporative cooling*
- *Humid air injection*

Inlet Cooling options



High ambient temperatures reduce load at most critical time

High Summer Temperatures Lead to High Air Conditioning Loads that become Major Contributors to the Peak Power Demand



Source: Scot Duncan Presentation at ASHRAE June 2007

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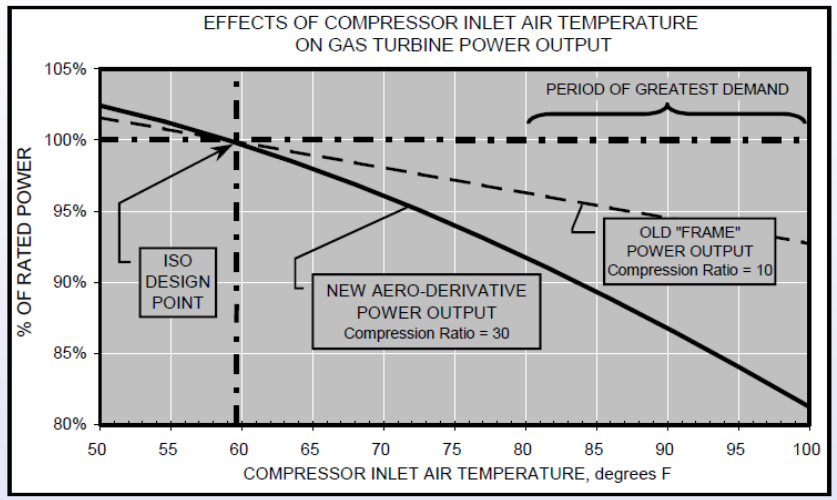
Capacity decreases with rising temperature

CT Power Plants' Generation Capacity Decreases with Increase in Ambient Temperature



Up to 19% capacity loss at peak demand for this CT

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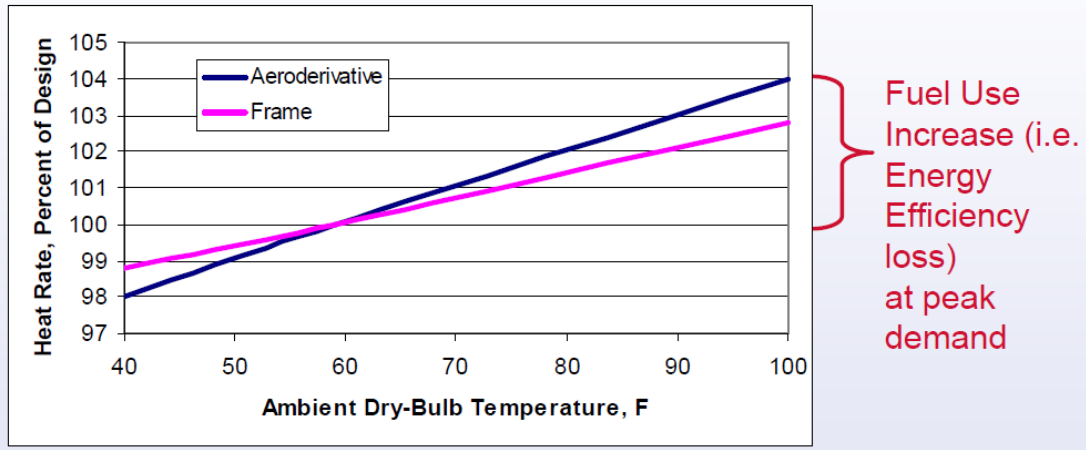
Impact of ambient air temperature on heat rate

CT Power Plants Energy Efficiency Decreases (i.e. Heat Rate Increases) with Increase in Ambient Temperature



Fuel Use Increase (i.e. Energy Efficiency loss) at peak demand

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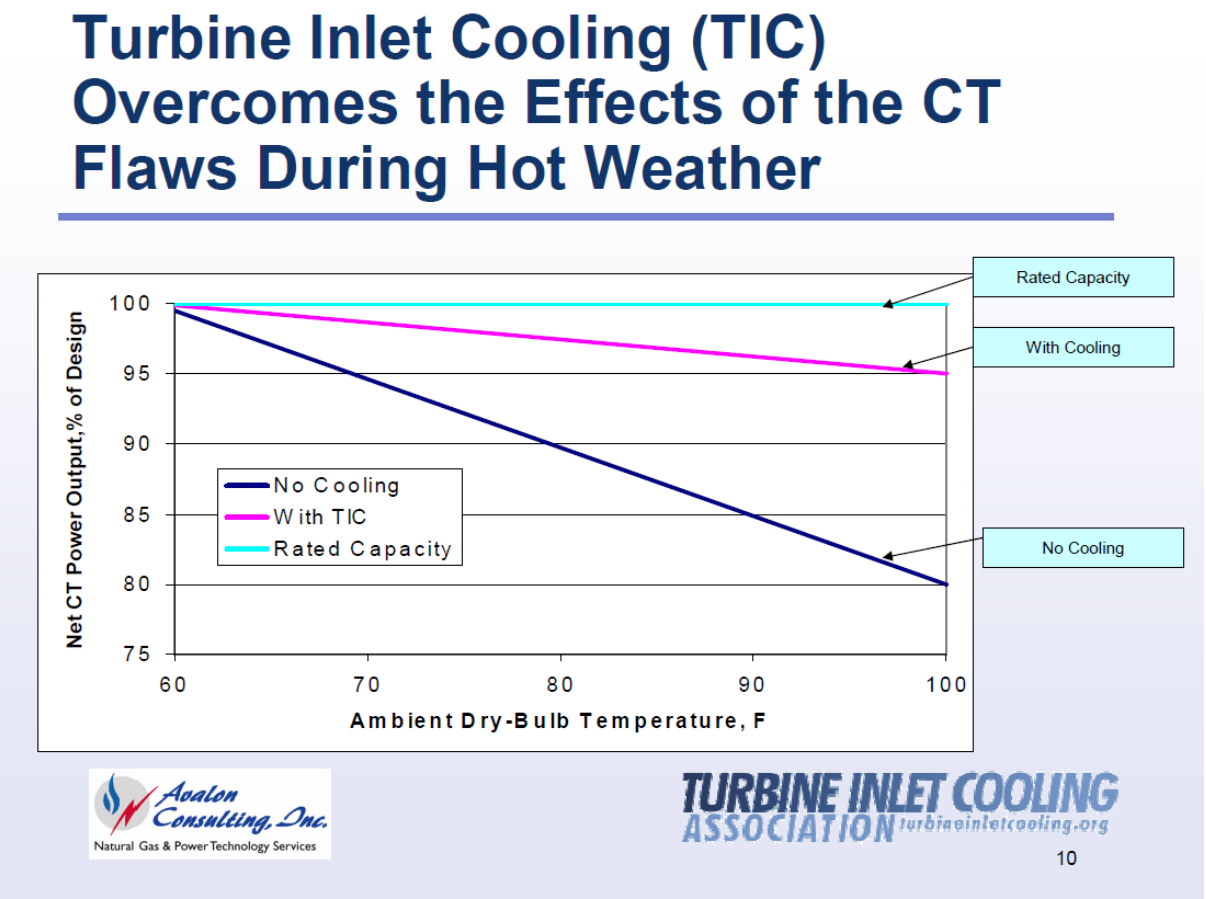
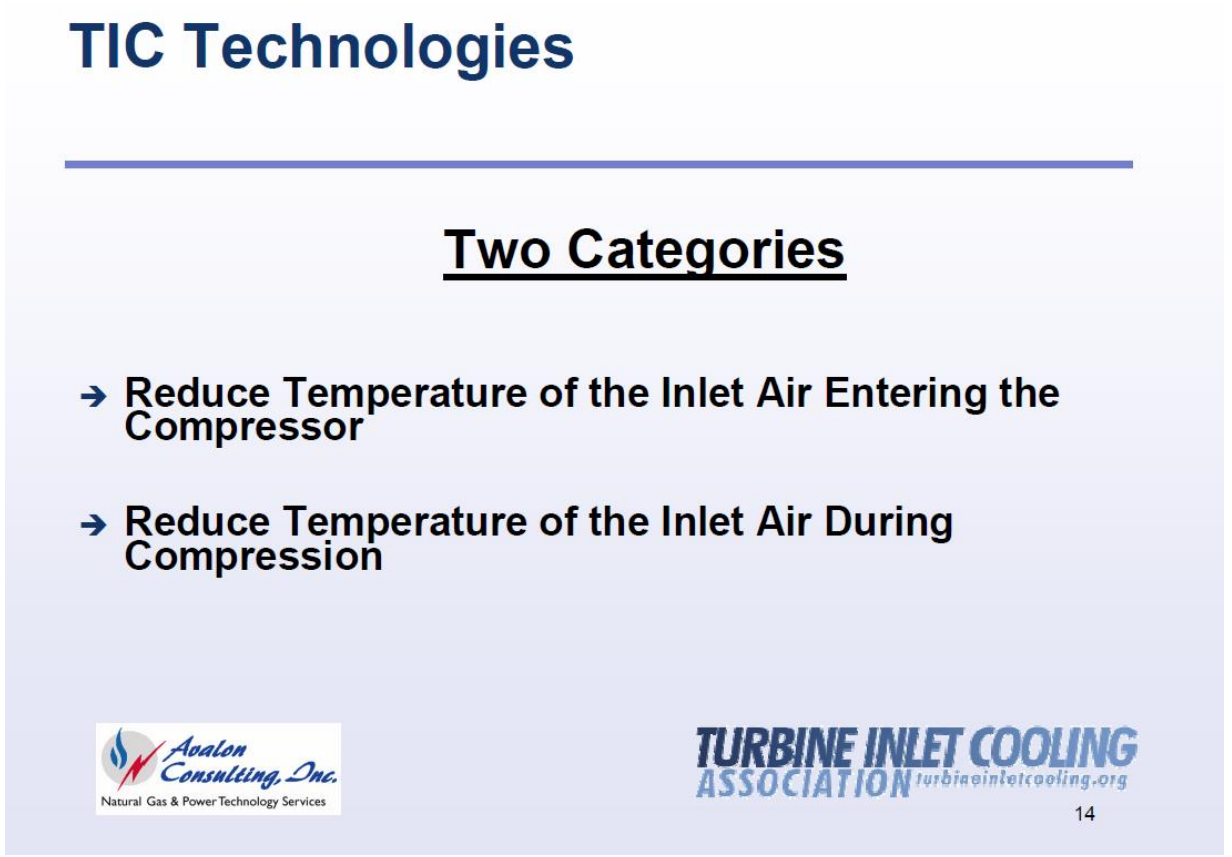
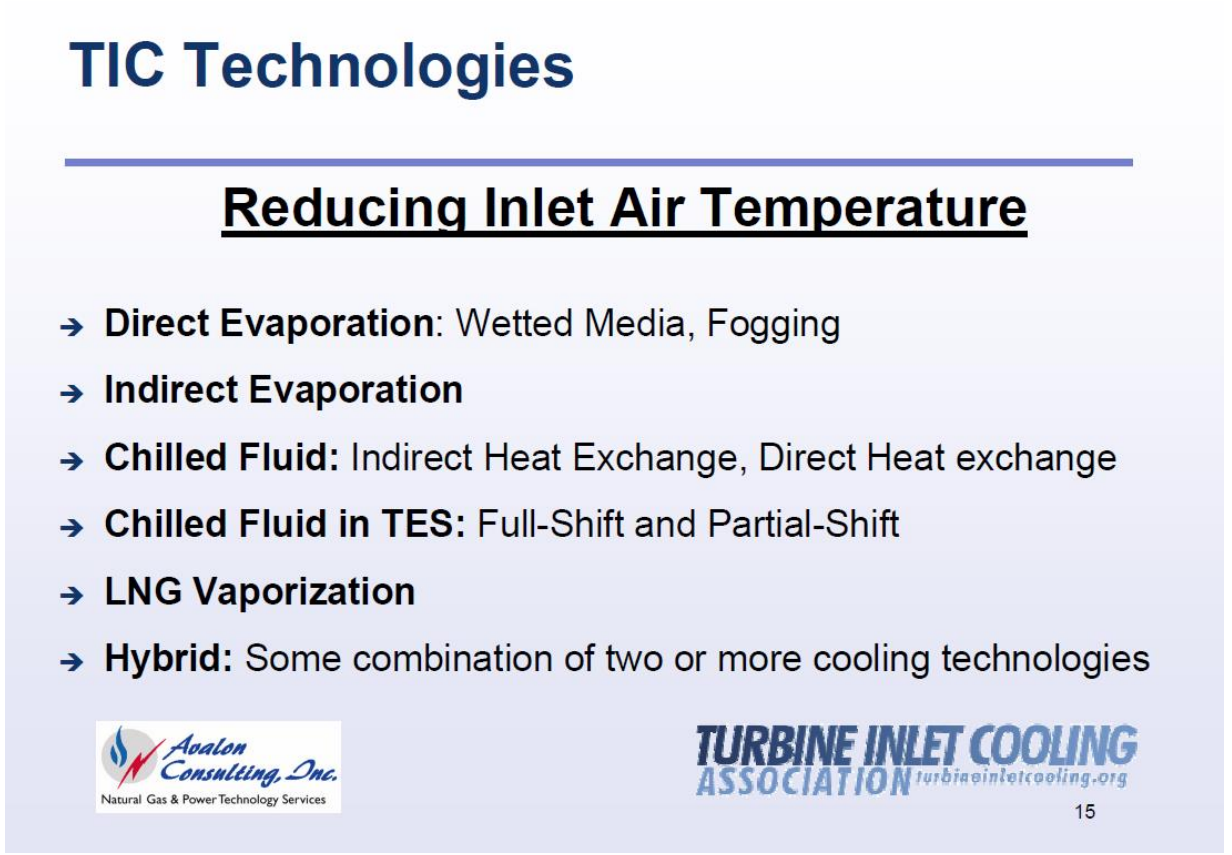
Inlet cooling increases output



Temperature reduction -Inlet air or during compression

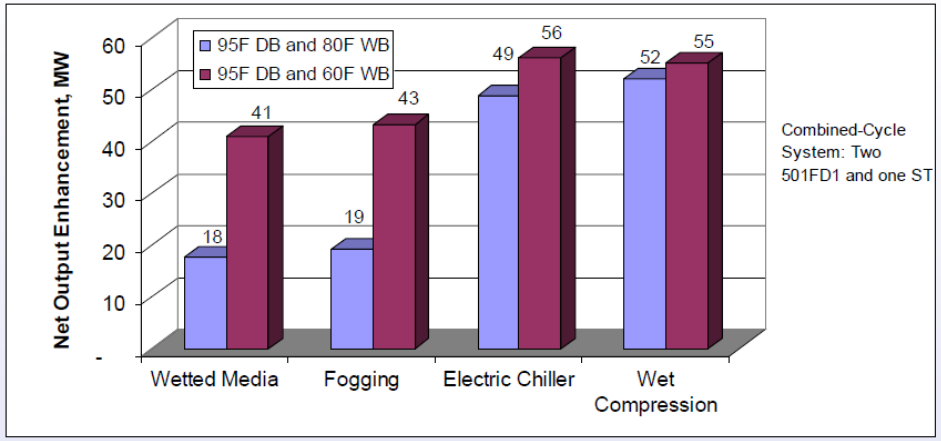


6 ways to reduce air inlet temperature



Examples of capcity enhancement with inlet cooling

Examples of the Effect of TIC Technology and Ambient Temperature on Capacity Enhancement



Sources:

Wet Compression: Caldwell Energy, Inc.

All Others : D.V. Punwani Presentation, Electric Power 2008

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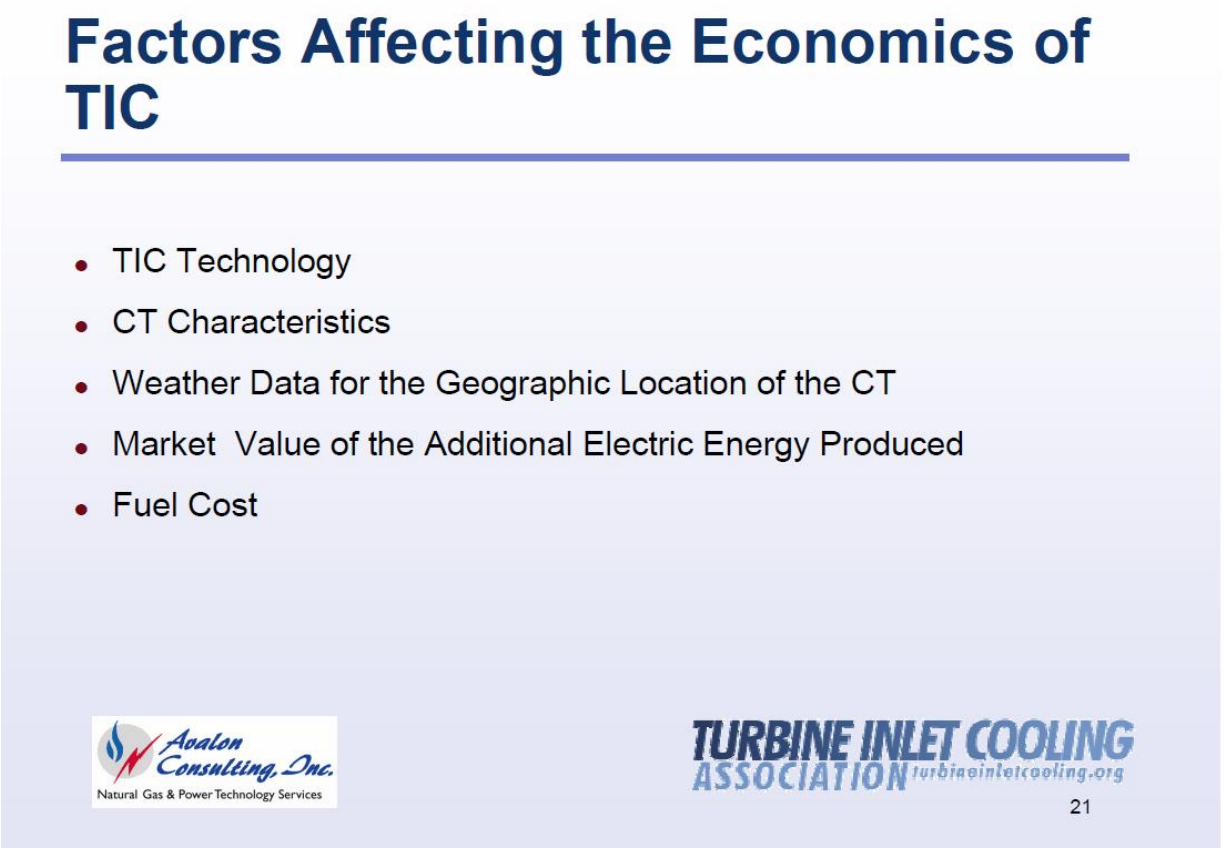
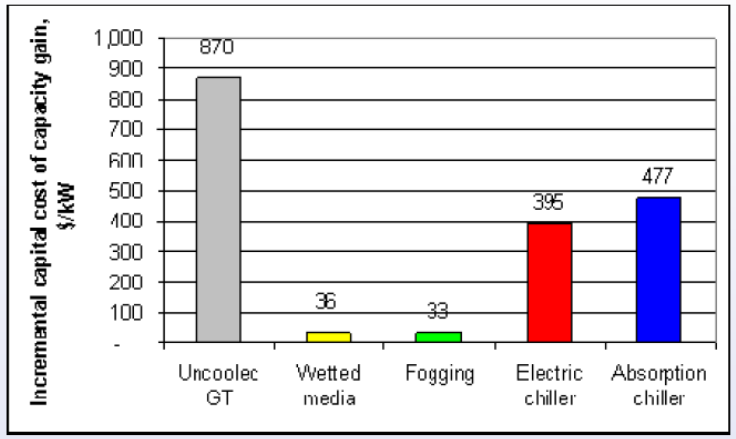
Factors determining economics of iinlet cooling



Incremental capital cost for inlet cooling

Examples of the Effect of TIC Technology on Capital Cost for Incremental Capacity



317 MW Cogeneration System Snapshot at 95°F DB and 80°F WB

Source: Punwani *et al* ASHRAE Winter Meeting, January 2001

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GTE’s Water Injection and Power Augmentation System

Water injection system

- GTE created a single skid that incorporated both the Water Injection and Power Augmentation systems. The system is capable of interfacing with virtually any control system and gas turbine fuel system. One of the specification requirements was to have a system that did not require control air or hydraulics to operate. GTE employed a high-speed electronic valve to control NOx water flow rates and a water actuated stop valve to provide positive, failsafe shutoff. Power augmentation was accomplished via VFD driven positive displacement pumps for inlet water fogging. This modular, all-electronic approach created a universal fit system that easily interfaced with the two different turbine fuel and control systems.

results

- NOX levels achieved: GE Frame 5: 74-76ppm P&W FT4A: 68-70ppm
- • Power augmentation increase: 5-8% adjustable, based on demand and ambient conditions
- • Water Injection and Power Augmentation incorporated into one system
- • Commonality of design across GE and Pratt & Whitney engines

Steam injection at PGE Gorzow

- Summary. The impact of steam injection upon a gas turbine and a combined power plant performance has been investigated. This article describes and summarizes possibilities of modification for current gas turbine in PGE Gorzow power plant into the Cheng cycle. Our modification deals with a thermal cycle, in which steam produced in a heat recovery steam generator is injected into the gas turbine's combustion chamber. It has been proved that an increase of the mass flow rate of the expanded exhaust gases causes an increase in both the power and efficiency of gas turbine. Steam injection also helps to reduce NOx formation and is profitable from a thermodynamic, economic and ecological standpoint. The numerical analysis of thermal cycles, before and after the modification, has been carried out by means of an in-house COM-GAS code and Aspen Plus commercial package
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