

Under the Patronage of the Minister of Environment Water & Agriculture
Eng. Abdulrahman bin Abdulmohsen Al Fadhili

منتدى المياه السعودي
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"Sustainable Water.. for Sustainable Development"

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Ministry of Environment Water & Agriculture
Kingdom of Saudi Arabia المملكة العربية السعودية



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Thermal desalination : outlook for existing assets management

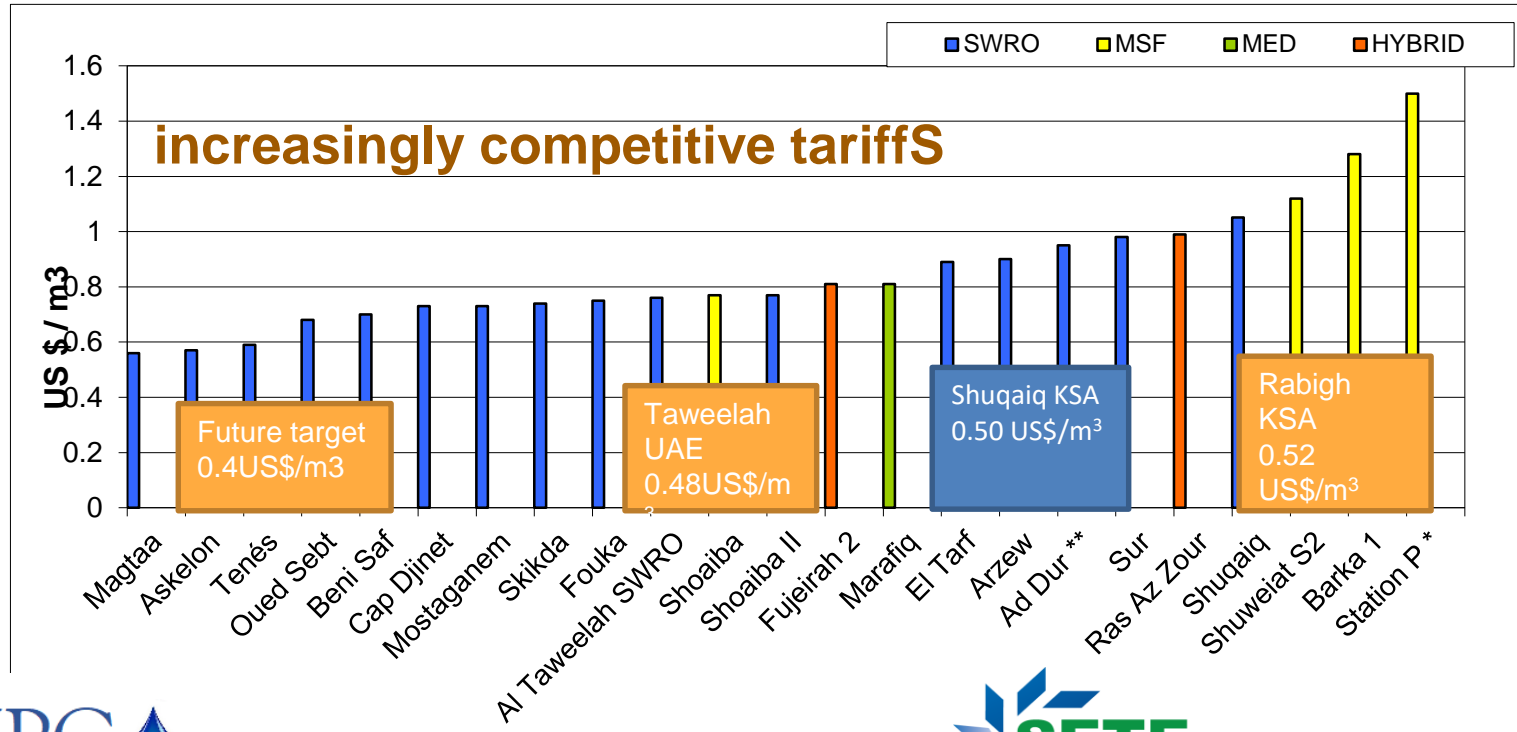
Thermal desalination : outlook for existing assets management



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Thermal desalination : outlook for existing assets management



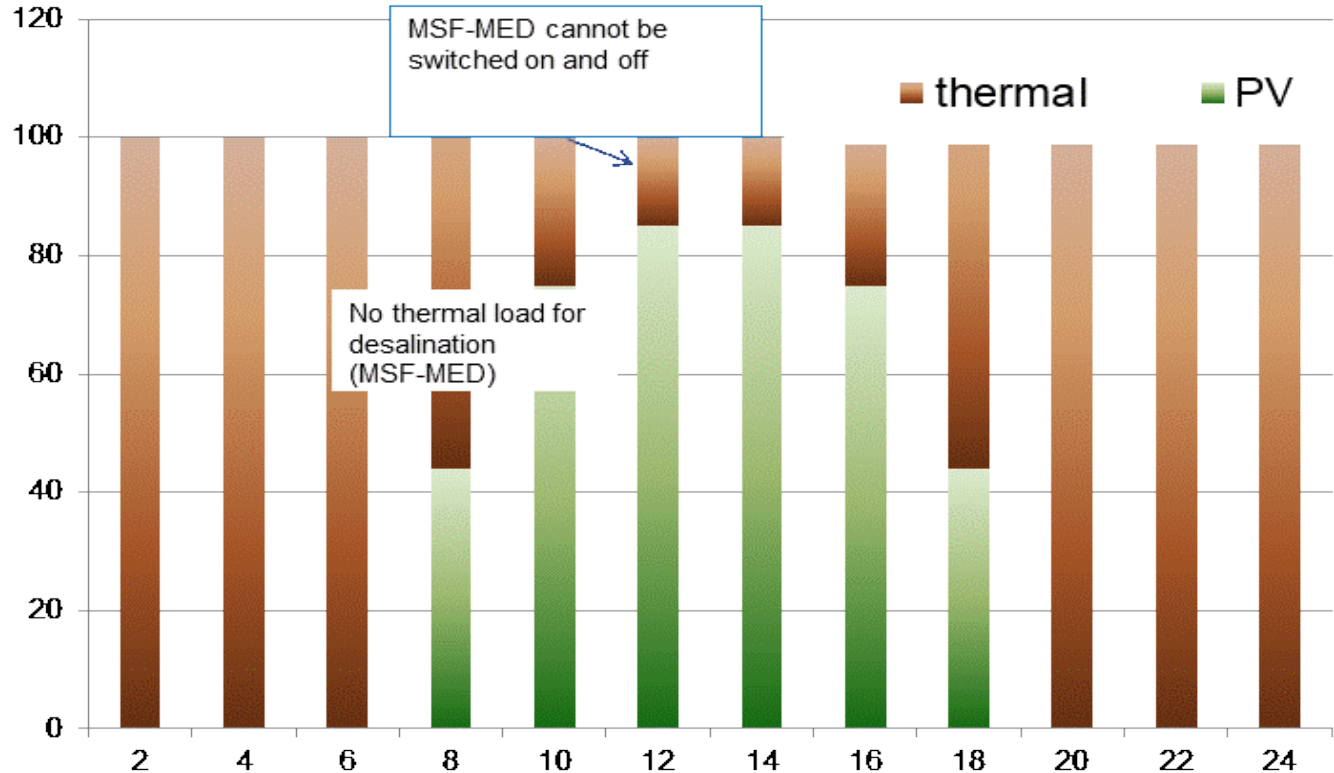
Thermal desalination : outlook for existing assets management



	Cost of water	Energy consumption
	US\$/m ³	kWh/m ³
Thermal (latest IWPP) 2010	1.2	20
SWRO	0.5	3

On surface to decommission a thermal desalination plant producing water at a tariff of 1 to 1.5 per US\$/m³ and huge energy costs appears a simple decision against the alternative of a SWRO plant at 0.5 US\$/m³ tariff and 2.9 kWh/m³.

Thermal desalination : outlook for existing assets management



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In reality the technicalities of the nexus between thermal power and thermal desalination are much more complex

- The first challenge is how to take advantage of the benefits of recent SWRO tariff and at the same time deal with the existing thermal fleet until the investment costs are recovered.



- Azzour North completed and commissioned in the fourth quarter of 2016. costs \$650 million
- Ras Al Khair completed and commissioned in 2015 cost US\$7.2 billion (with power plant)
- Etc etc

Thermal desalination : outlook for existing assets management

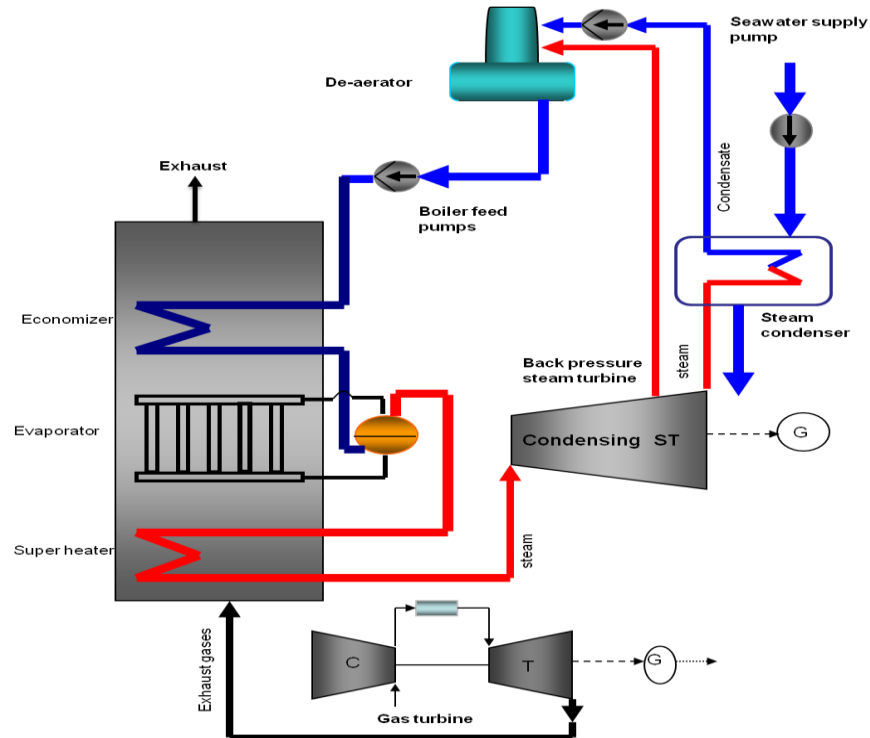
The other challenge is related to the water and power nexus. The majority of the existing large thermal desalination plants operates in a cogeneration scheme with the power plant; as such the desalination plant is the condensers for either a back pressure steam turbine or a pass out steam stream.



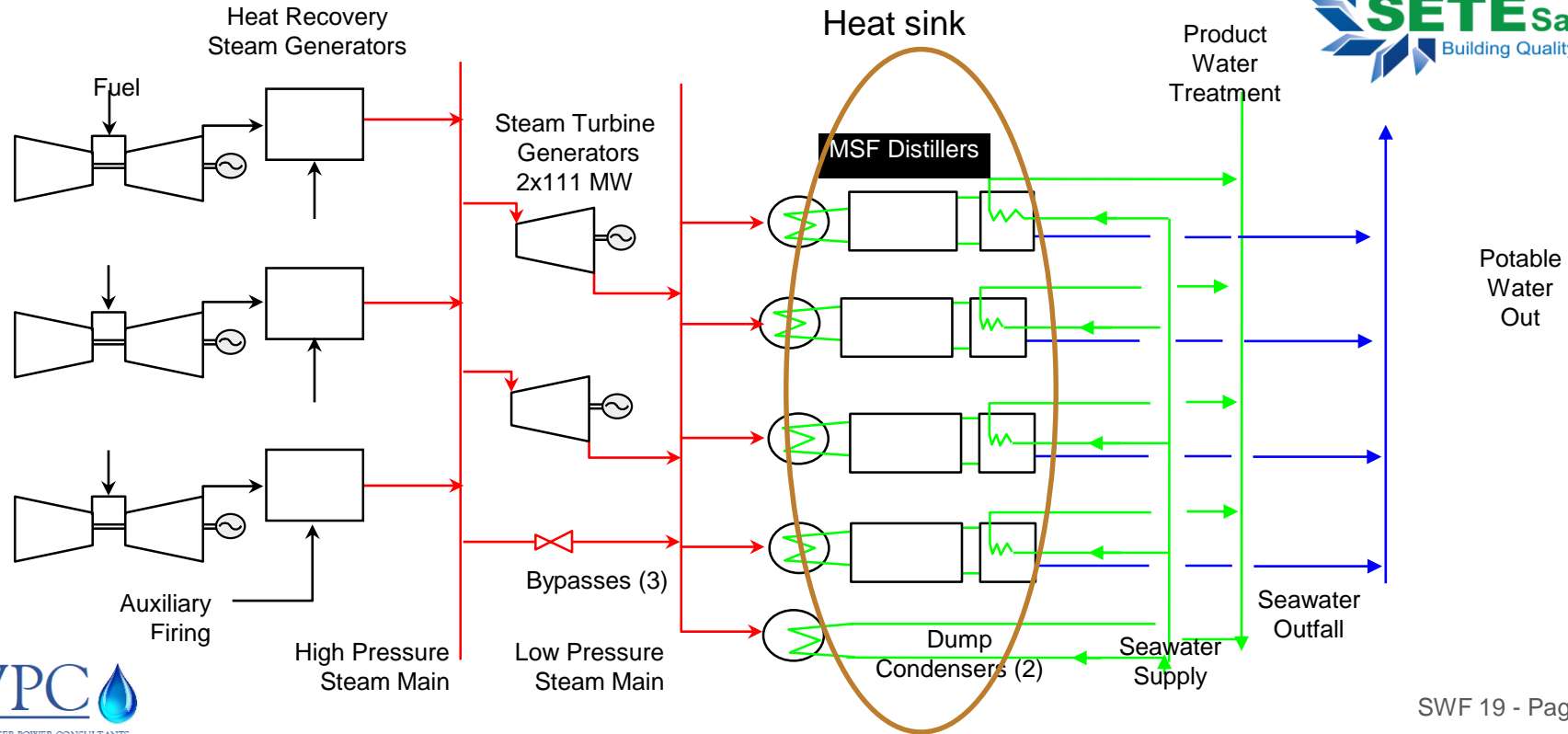
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Power plants require a heat sink where to condense the steam that has been used in the steam turbine.

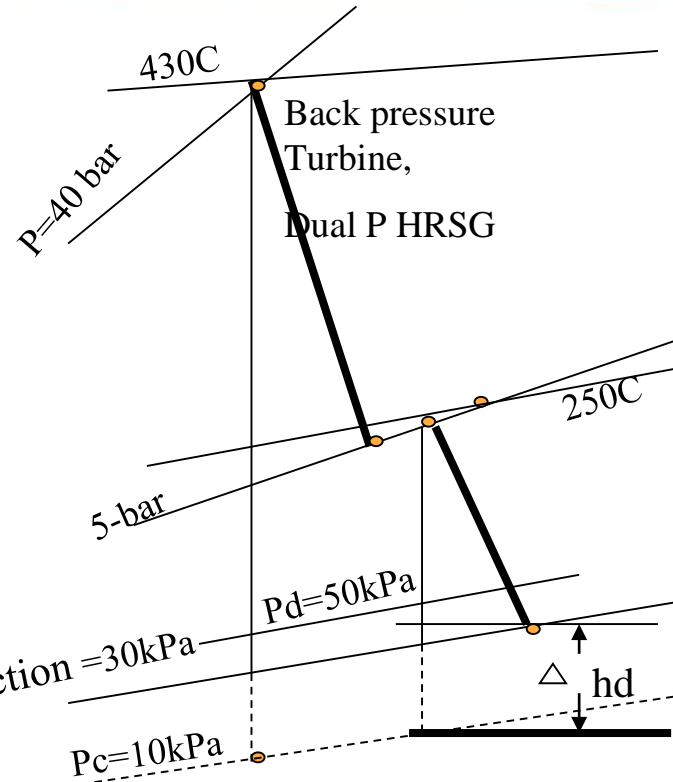
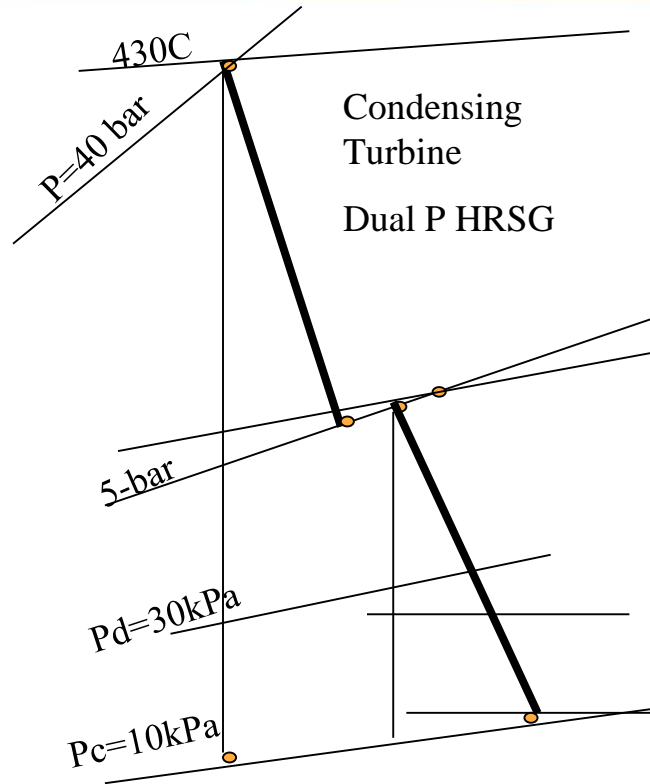
A large amount of seawater through the steam condenser is needed



Thermal desalination : outlook for existing assets management



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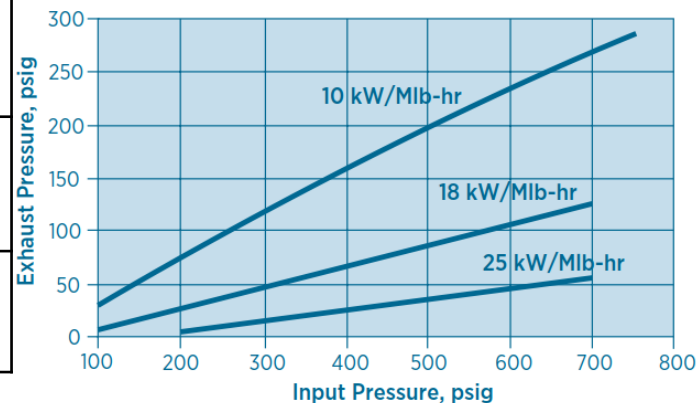
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There is no point to decommission a thermal desalination plant if there no possibility of taking advantage of this ΔH .

Thermal desalination : outlook for existing assets management

Extraction pressure	bar	5	4	3	2.5	2	1.8
Specific steam consumption	Kg/kWh	7.8	7.1	6.6	6.2	5.9	5.7
Turbines power	MW	385	422	455	488	504	526

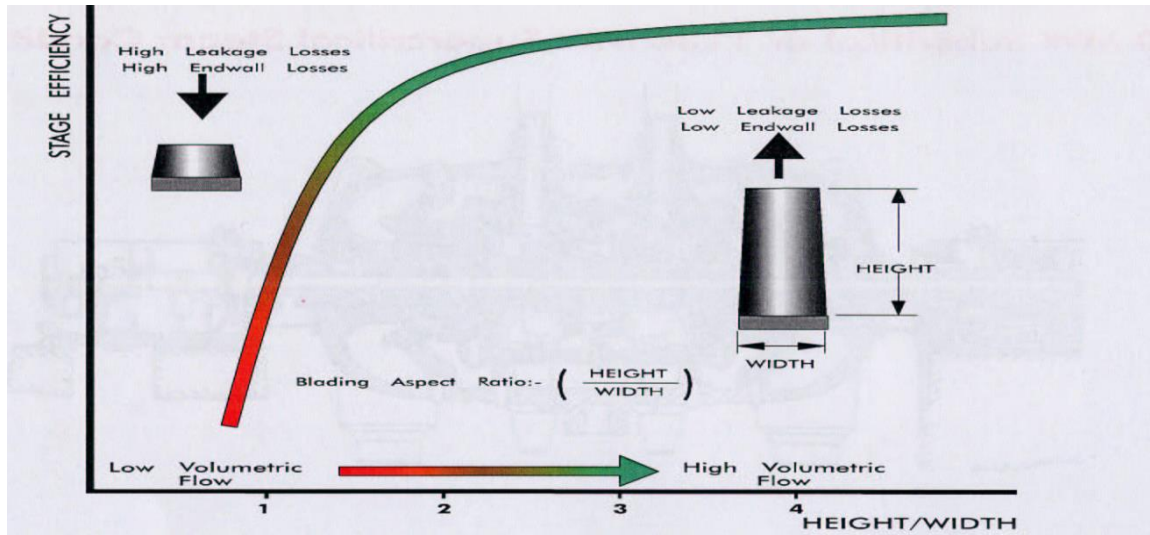
Backpressure Turbogenerator Generating Potential, kW/Mlb-hr



Note: Assumes a 50% isentropic turbine efficiency, a 96% efficient generator, and dry saturated inlet steam.

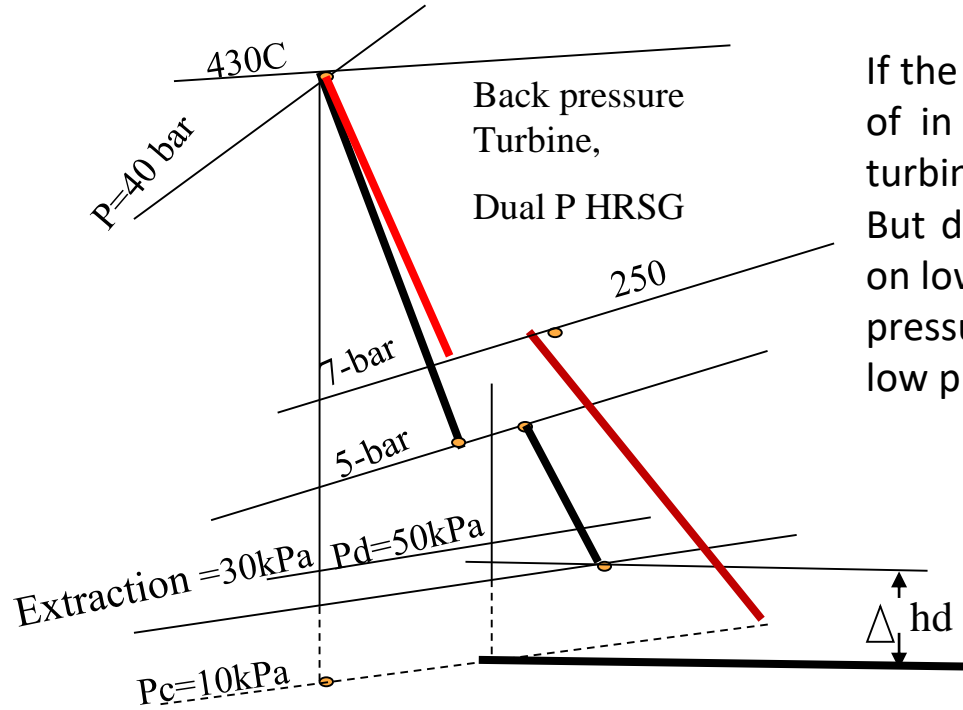
The table shows an estimation of the potential additional power that would be able to be generated for a set of 40 bar steam turbines operating at 430C feeding 100 MIGD MSF systems at various extraction pressures

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Steam turbine blades however are designed for a certain volumetric flow and cannot change

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If the back pressure is high in the order of in excess of 5 bar a low pressure turbine can be retrofitted.

But design for MSF and MED is based on low pressure such as 2 to 3 bar back pressure it is highly unlikely to get a low pressure turbine.

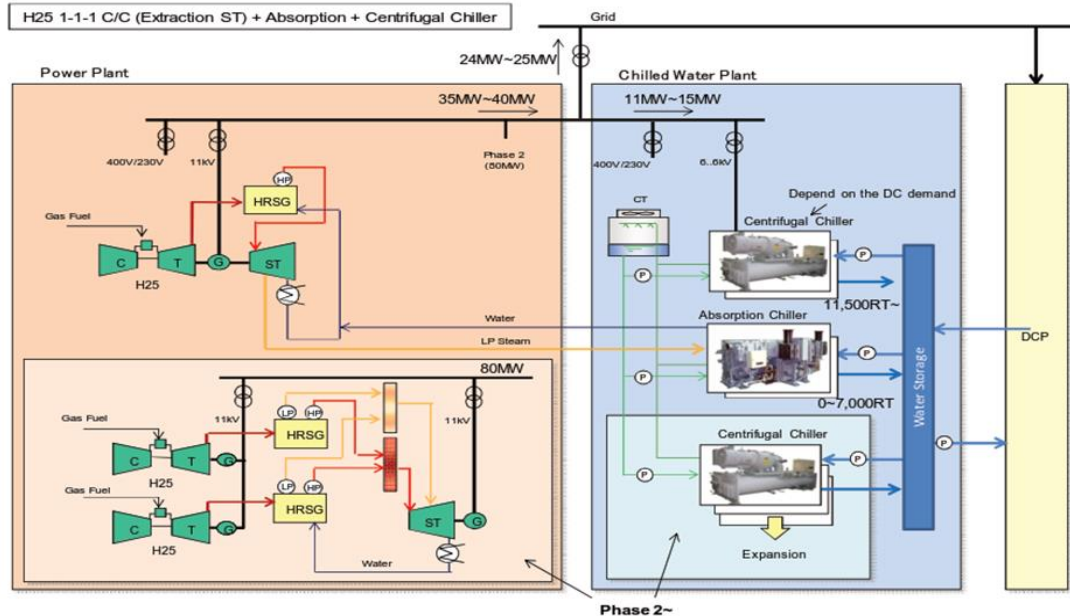
In some cases re-profiling would be possible ? But with efficiency losses





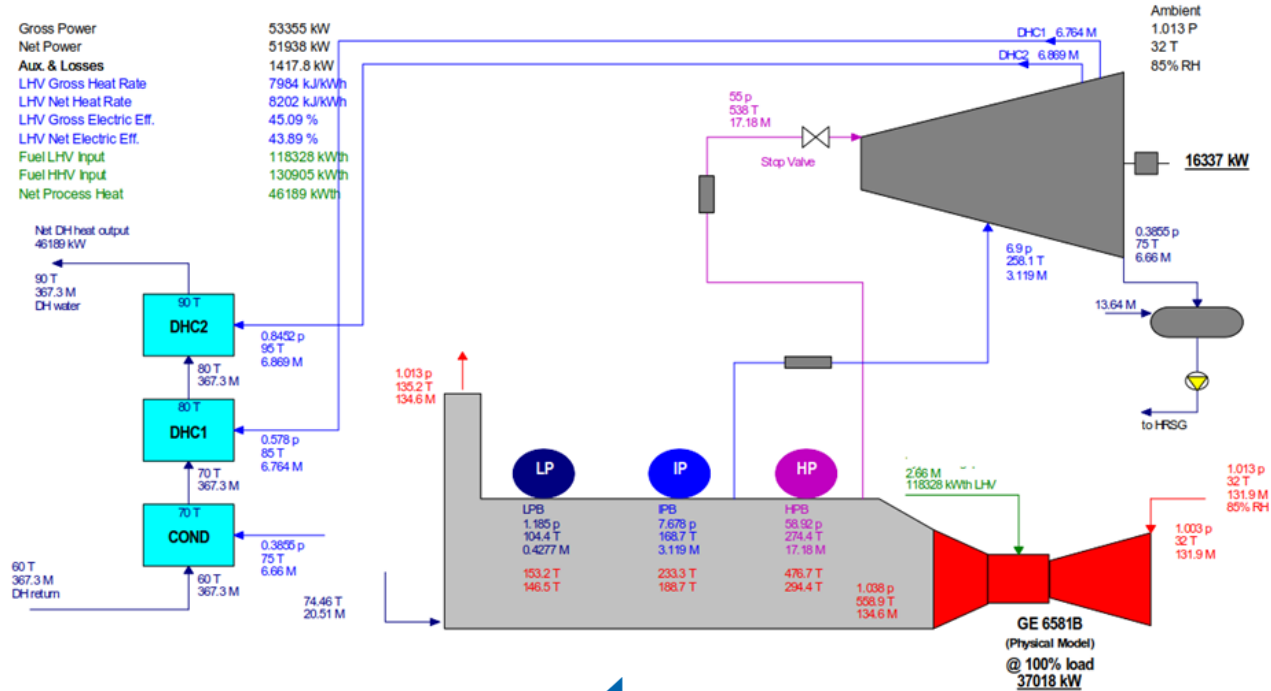
Limited manufacturers of such low pressure steam turbine/retrofits is also a constraint.

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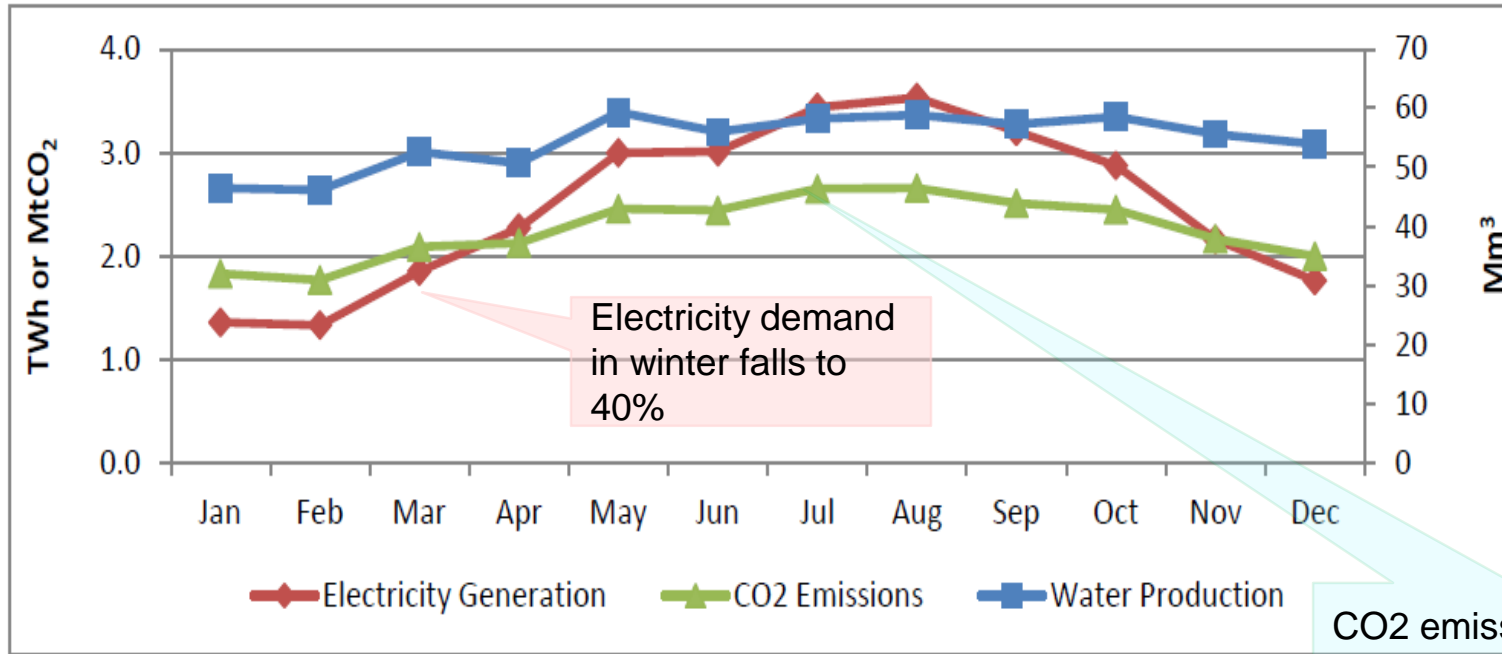
- Power generation can be used to drive the rotary chillers
- Low pressure steam through extraction or through a low pressure generation source can be used to drive Vapour Absorption Machines

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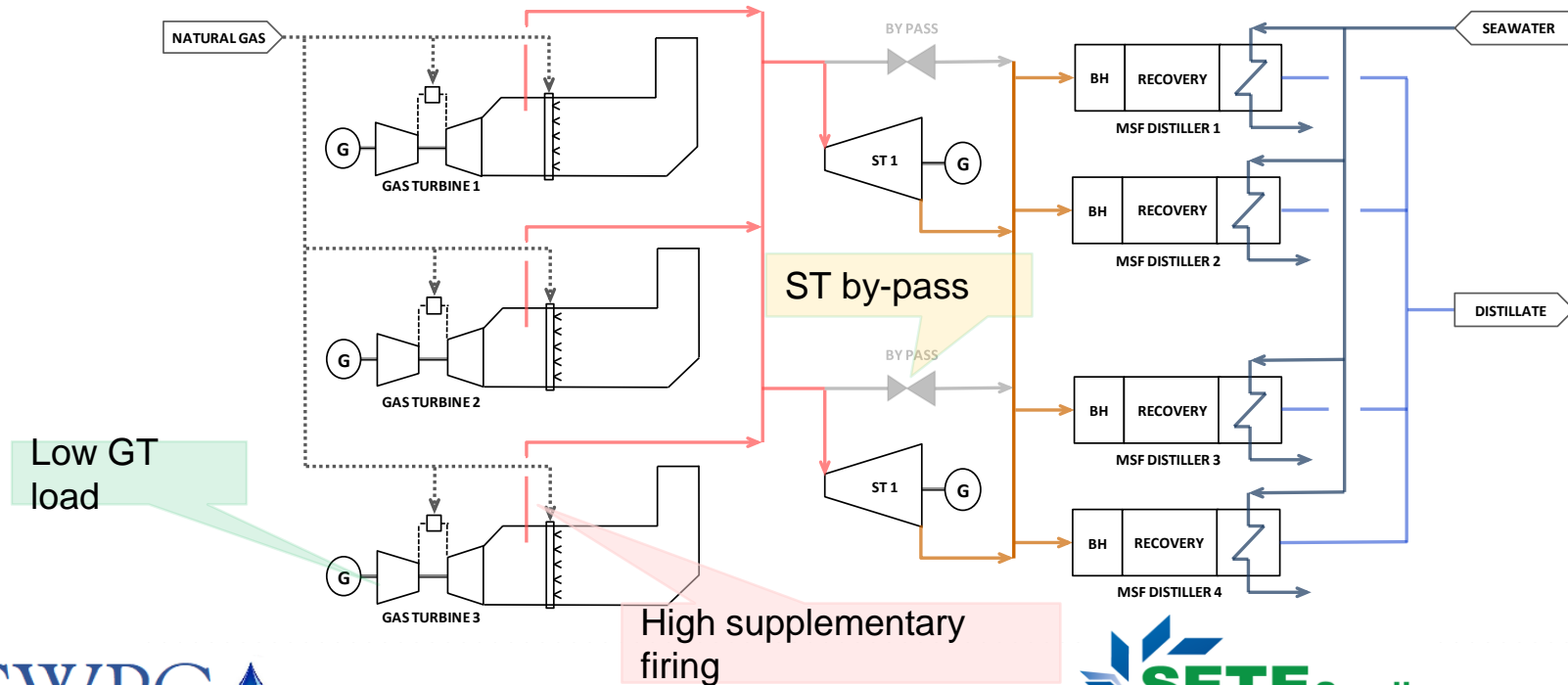
Based on the available surplus steam due to MSF retirement, configuration of the power-chiller integration will be modelled.

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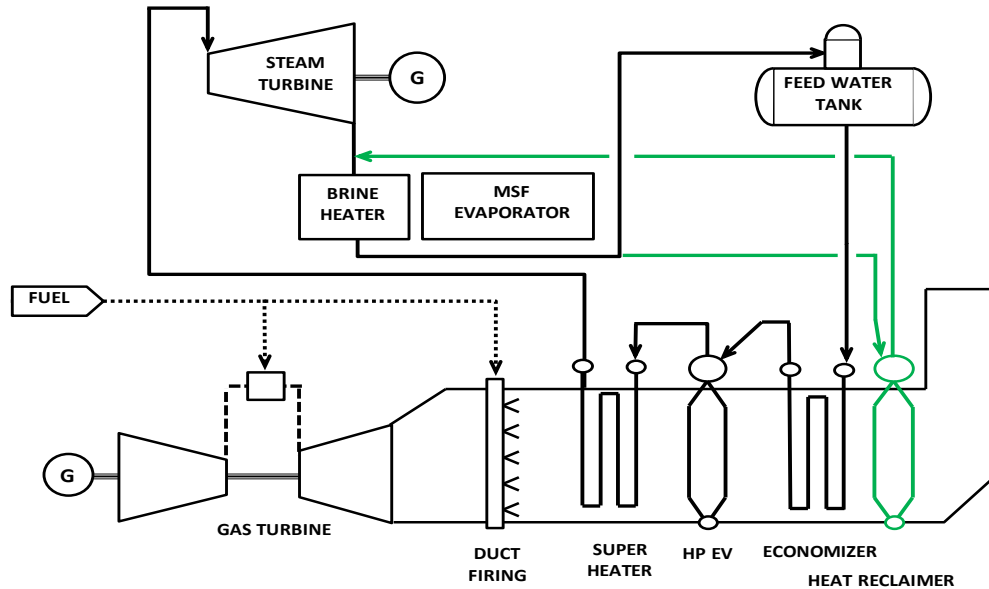


CO2 emissions follow the water (not power) profile

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A new low pressure cycle has been retrofitted taking advantage of the waste heat at low temperature.

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Taweelah A2 Power-Desalination Plant, commissioned in 2001, was the first IWPP in the Gulf region under the privatization scheme promoted by ADWEA

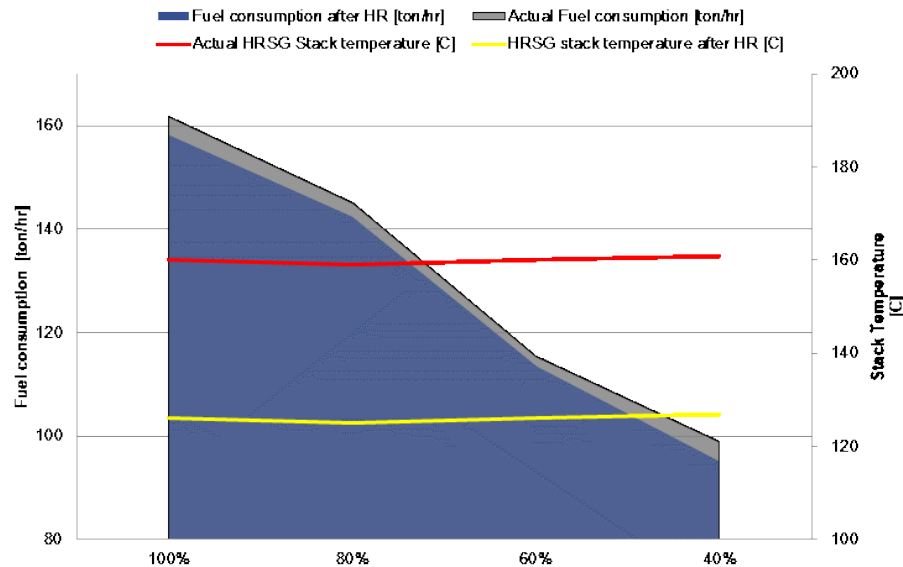
Producing 720 MW by a Combined Cycle and 50 MIGD by four MSF distiller, was considered at that time the most efficient dual-purpose plants operating in the region

A high level of supplementary firing in the HRSG is required to match the large seasonal power-water demand fluctuations



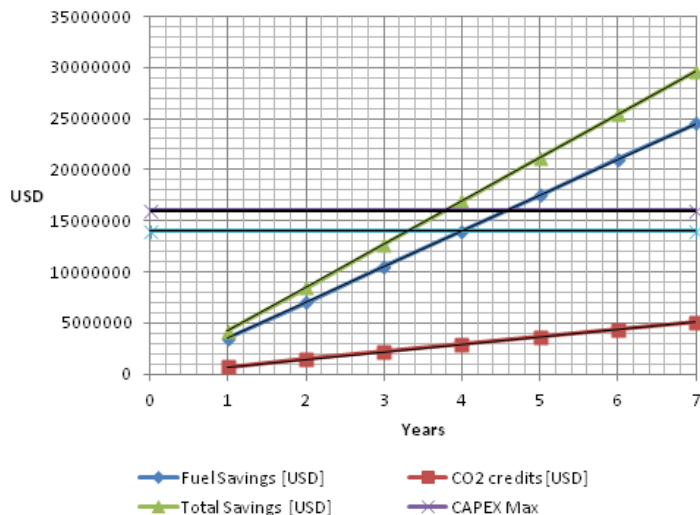
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The same project is now under installation in Fujairah

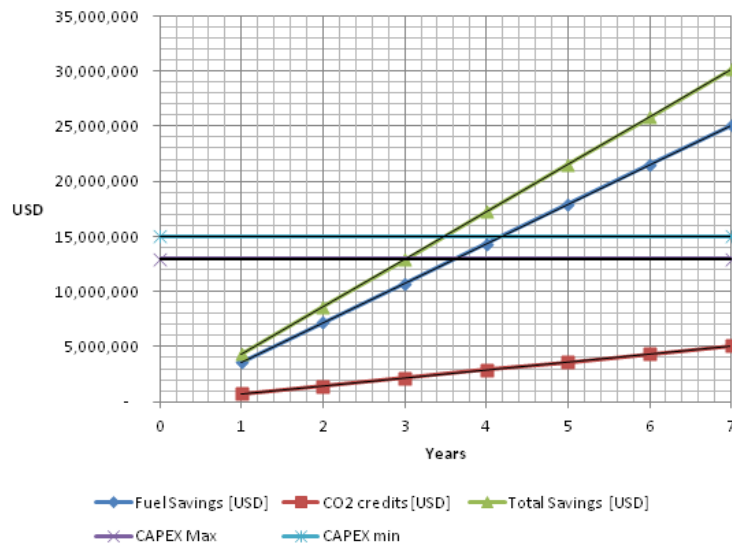


Thermal desalination : outlook for existing assets management

Scenario 1 - Break Even Analysis Fuel savings
Fuel Price 3.62 USD/MMBtu



Scenario 2 - Break Even Analysis Fuel savings
Fuel Price 3.62 USD/MMBtu



Thanks



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