District Cooling
Water Resource Management

Issa Qandeel, P.E., LEED® AP, MBA

OUTLINE

- GCC Construction Projections
- District Cooling Overview
- Benefits of District Cooling
- GCC District Cooling Facts & Figures
- Water Resource Management
- Moving Forward

GCC Region Construction Figures

- Increase demand due to rise in population & other milestone events.
- In 2010 over $200 billion construction contracts awarded (40% buildings, 40% energy, 20 infrastructure).
- > $900 billion real estate projects are estimated to be underway.
- In the coming few years, > 65% of GCC projects fall under “Buildings”

How does it work

District Cooling System consists of:

1. Central chilled water plant
The plant has reliable and efficient industrial chillers. It is monitored 24 hours a day by qualified operation teams.

2. Pipe distribution network
Chilled water moves to the buildings through insulated steel pipes.

3. Customer connection
The chilled water reaches the customer at 5.5 °c, where it is cooled by transferring the heat through the energy transfer station.

District Cooling in Qatar

The Pearl-Qatar

West Bay-Doha

Lusail

Katara

Mushaireb

Barwa City

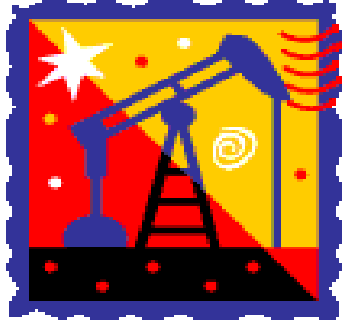
Qatar Foundation

Qatar University

Al Waab City

New Doha International Airport

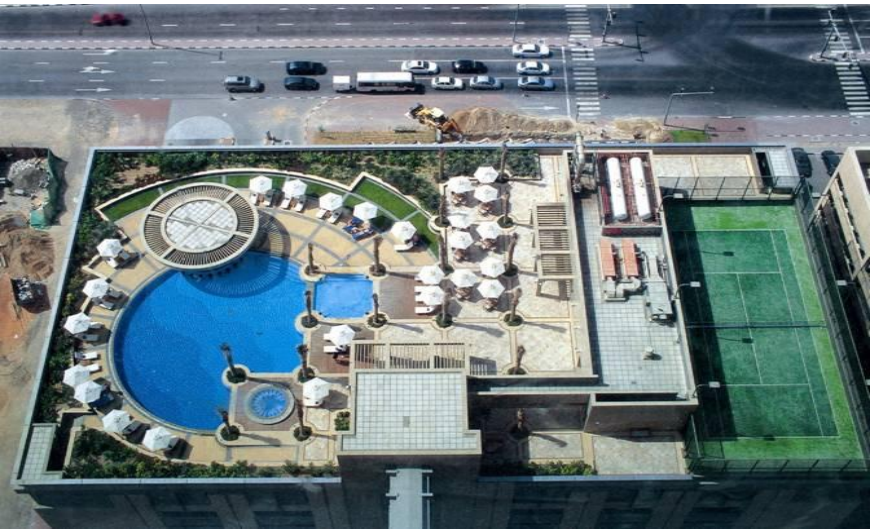
Benefits of District Cooling



- Energy Efficient: DC *offers energy saving of more then 40-60% compared with conventional air-conditioning systems).*
- Environmental Advantage: *Energy Savings Translate to Lower Power Generation Requirements, Hence; less CO2 & other greenhouse gases and contaminants to the environment.*

Benefits of District Cooling

- Architectural Benefits: reduces customer plant space by 70%, clean roof (sky gardens, PV systems, etc).
- Less Noise & Vibration.
- Decentralized Plume.



GCC District Cooling Facts & Figures

- DC has proven to be the solution to the challenge of ‘environment, energy and economy’.
- It has been implemented world-wide since the turn of the 20th century & in the GCC region as early as the 1960’s.
- DC has vastly grown throughout the GCC region in the last few years.
- Current DC capacity is approximately 3-million TR & expected to reach over 7-million in the coming 3-4 years.

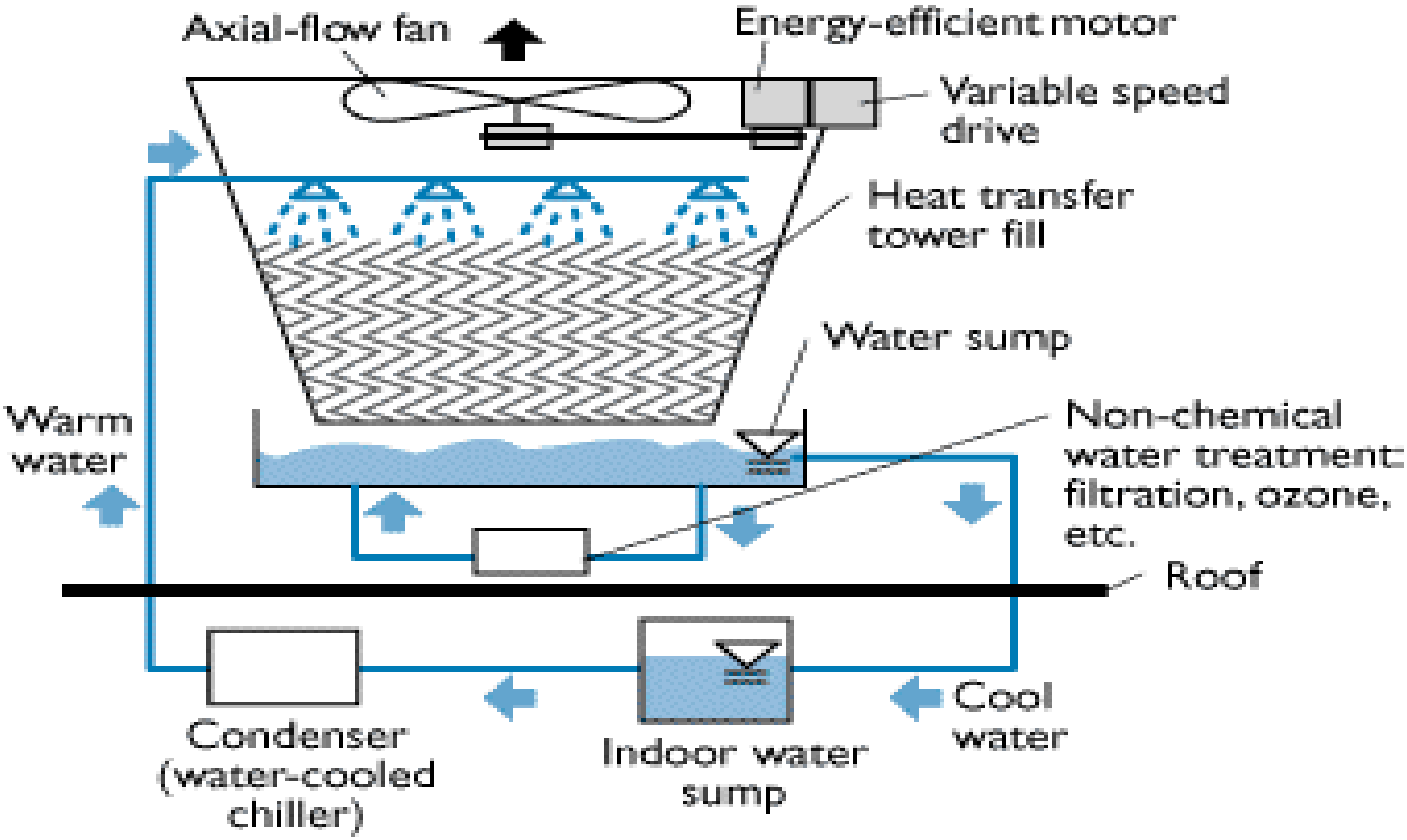
Water Resource Management

DC relies on water for its operations to make-up for:

- Cooling Tower Evaporation and Drift Losses.
- Blow Down due to Increased Solids Concentration.

DC discharges a portion of the required water out of the plants: to get rid of the concentrated minerals and solids due to evaporation.

Water-Cooled Chillers w/Cooling Towers



Water Type & Source Options

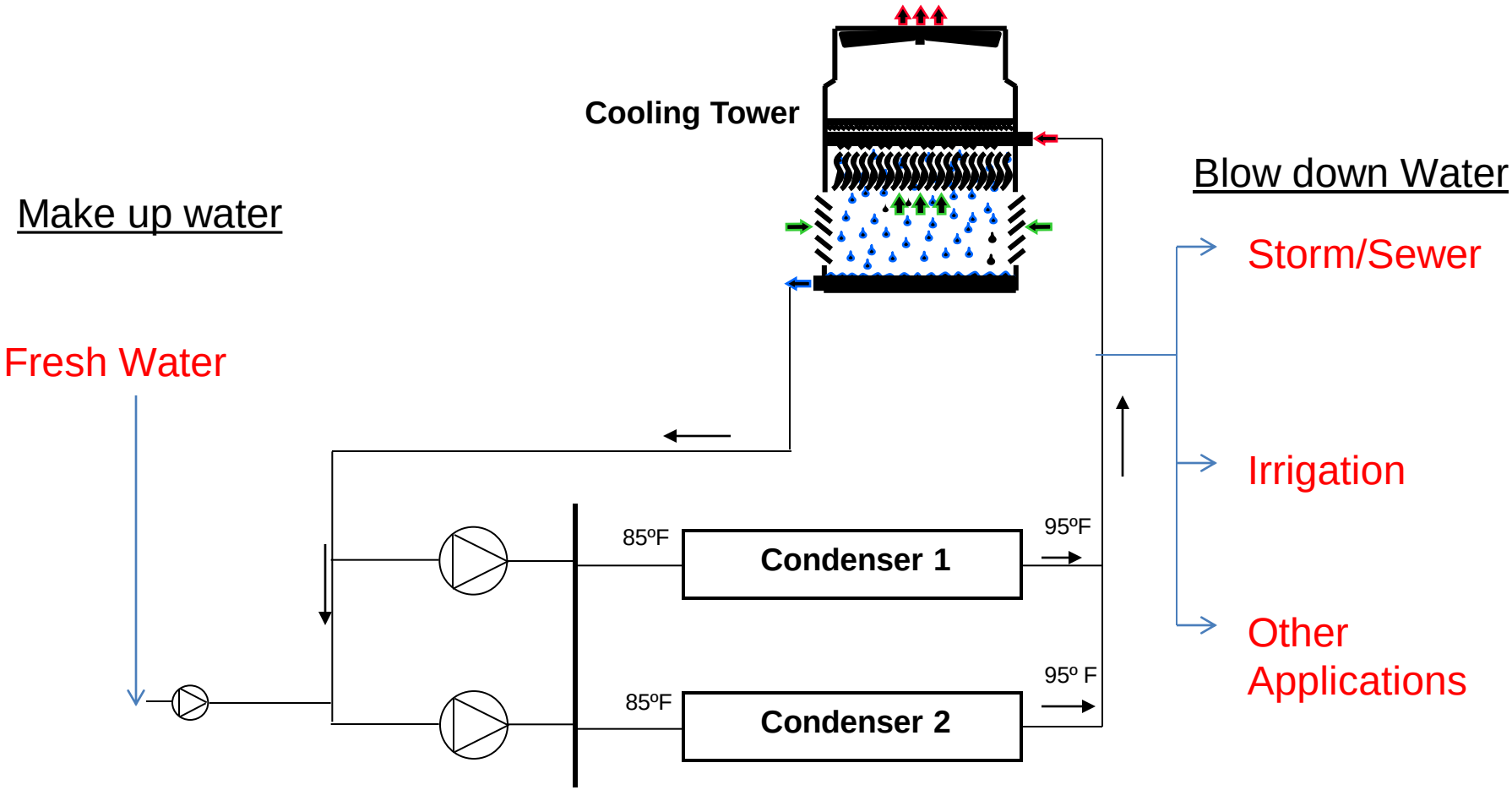
- Potable, RO, & Light-Grey Water:
  - ➢ No Special Equipment Design
  - ➢ Minimal Chemical Treatment
  - ➢ Most Advantageous To Use
- TSE Water:
  - ➢ Special Equipment Design (Filtration, Polishing)
  - ➢ Additional Chemical Treatment

Water Type & Source Options

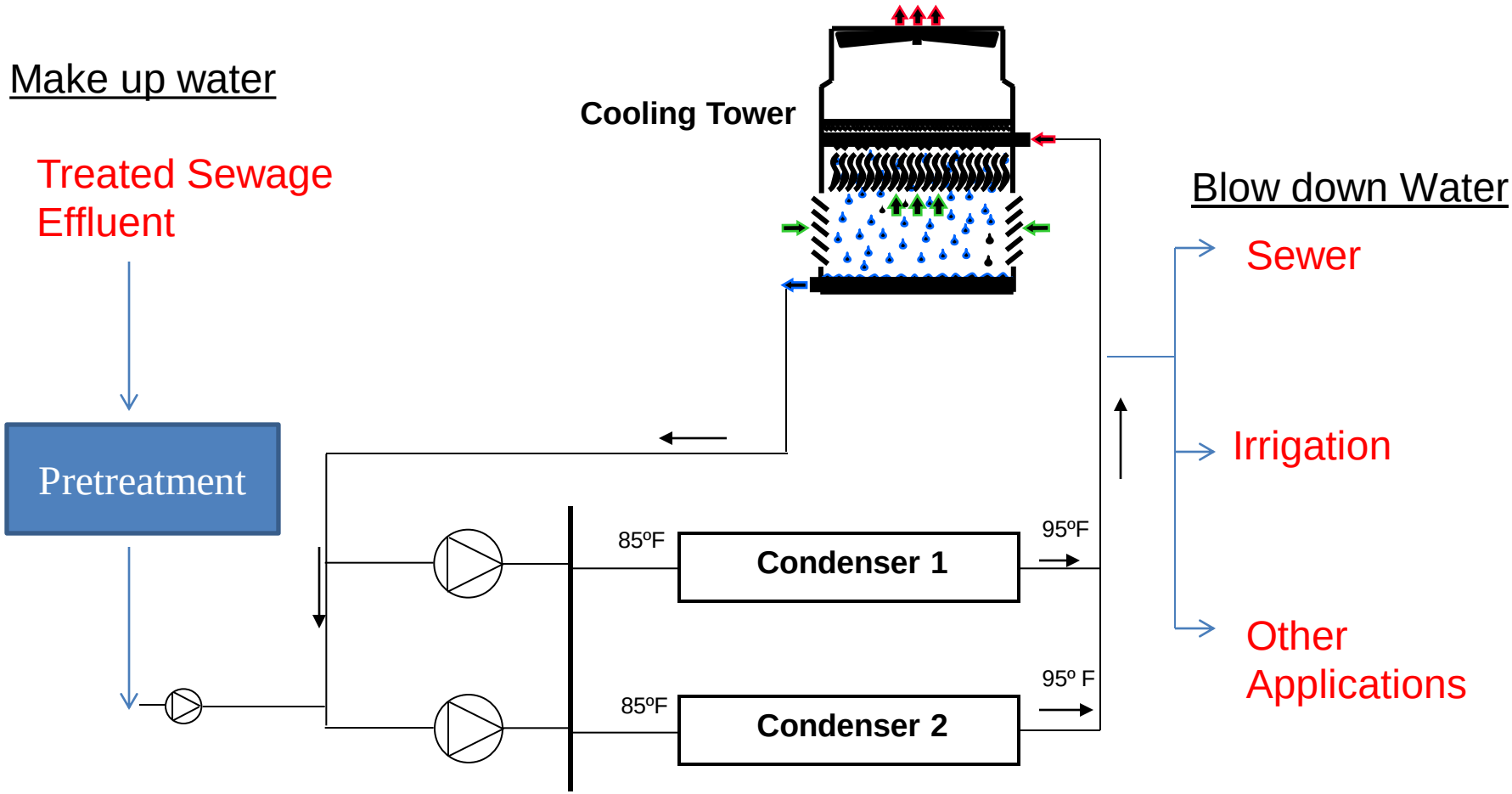
- Sea Water Make-Up:
  - Special Condenser & Cooling Tower Design
  - Additional Filtration and Chemical Treatment
  - Different piping material & arrangement

- Direct Sea Water Make-Up:
  - No Cooling Tower Required
  - Length of the Pipeline to be Laid Depends Upon Temperature Of Sea Water
  - Higher Pumping Flow Rates and Pressures
  - Special Condenser Design
  - Special Chemical Treatment
  - Different piping material & arrangement

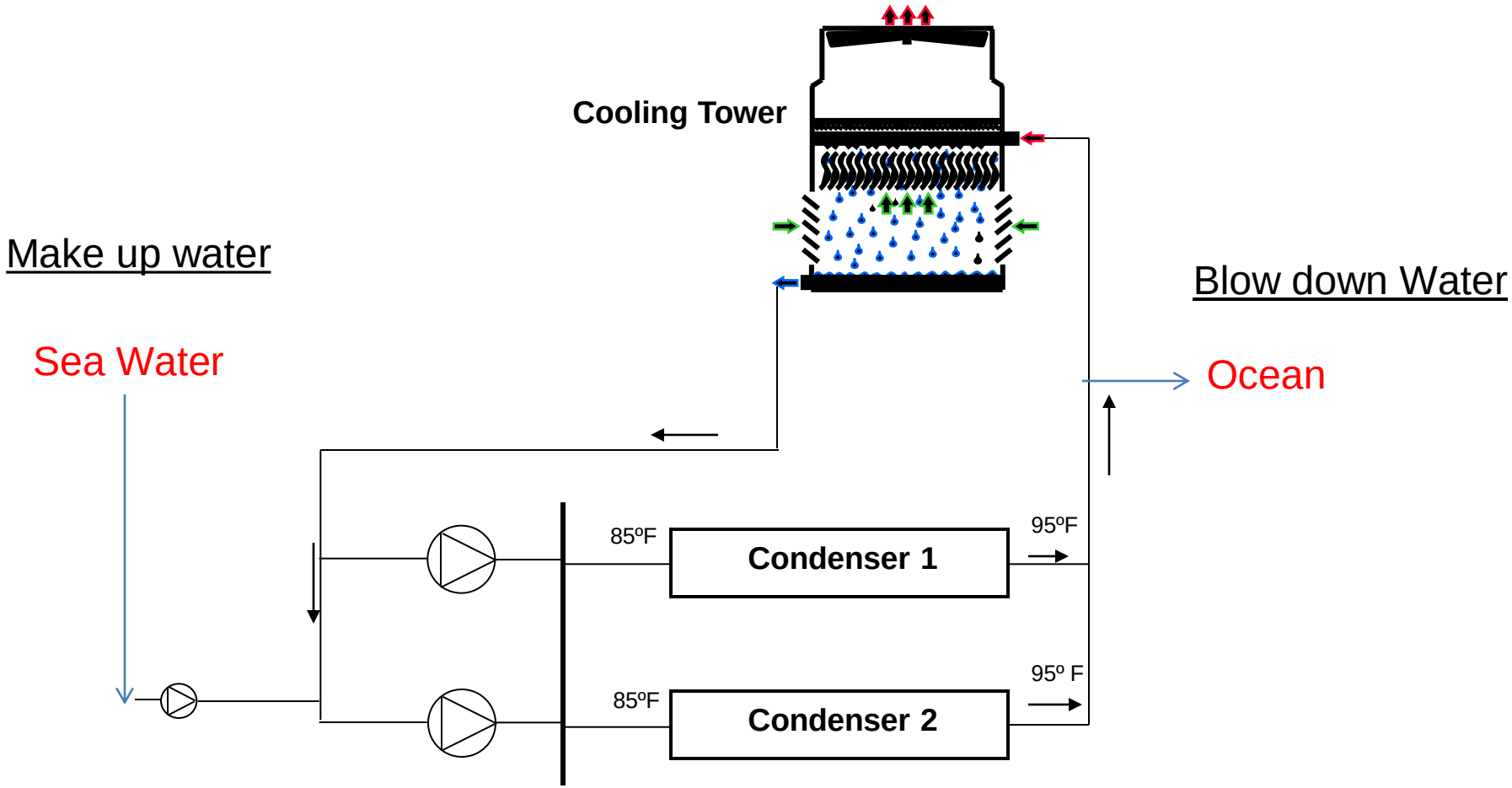
Flexibility in Make Up source/Discharge



Flexibility in Make Up source/Discharge



Flexibility in Make Up source/Discharge



Anticipated Cooling Water Requirements-GCC

Million m^3/yr

System Configuration	Current (3-M TR)	~ 2015 (7-M TR)
Decentralized	45.9	107.2
District Cooling	36.7	85.8
Estimated Saving	9.2	21.4

Basis of Calculations & Assumptions:

- GCC DC Companies' utilize Efficient Water Management Processes.
- 50% Utilization of total DC Capacity.
- Study/Survey of Decentralized Systems Water Performance is underway. Expected to consume 25% over DC.

Water Resource Management
Continuous Improvement

- Steps Taken to Reduce Water Consumption
  - Proper Chiller & Cooling Tower Maintenance
  - Advanced Automation & Monitoring
  - Water Quality Enhancement Through Mechanical and Chemical Systems
  - Blow Down Recycling
  - Collaboration with Water Treatment Experts

Qatar Cool Plant Performance

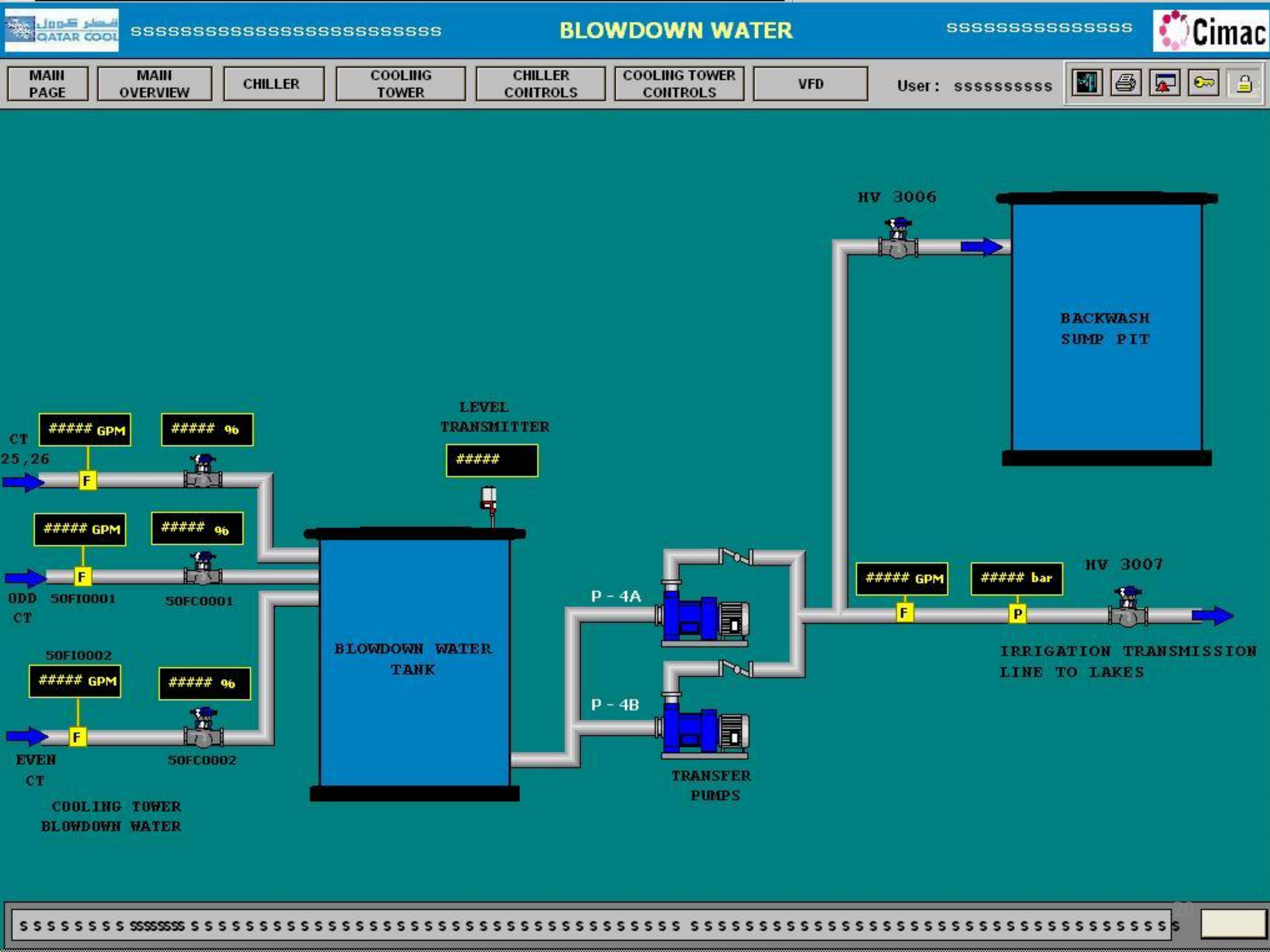
Performance Parameters	Year		
	2007	2010	2011
Electrical Power Consumption (kW/TR-Hr) (Industry Standard=1-1.1)	1.23	0.93	0.94
Water Consumption (US Gal/TR-Hr) (Industry Standard=2.0-2.1)	2.06	1.88	1.84

QC Water Saving @ West Bay ONLY (2009-2012) = 236,765 m^3 (around 15% from Industry Standard)

Makeup Water & Discharge Quantities @ Different Water Sources

Million m^3/yr

DC	Current (3M TR)		~ 2015 (7M TR)	
Water Source	Makeup	Blow down	Makeup	Blow down
Potable	36.7	7.3	85.8	17.2
TSE–Polished	40.4	8.3	94.4	19.4
Direct TSE	49.5	18.6	115.8	43.9
Sea	88.1	56.6	205.9	133.3



QATAR COOL
ssssssssssssssssssssssssss
BLOWDOWN WATER
sssssssssssssss
Cimac
MAIN PAGE
MAIN OVERVIEW
CHILLER
COOLING TOWER
CHILLER CONTROLS
COOLING TOWER CONTROLS
VFD
User : ssssssssss
HV 3006
BACKWASH SUMP PIT
LEVEL TRANSMITTER
#####
CT 25,26
GPM
%
F
GPM
%
ODD CT
50FI0001
50FC0001
50FI0002
GPM
%
EVEN CT
50FC0002
COOLING TOWER BLOWDOWN WATER
BLOWDOWN WATER TANK
P - 4A
P - 4B
TRANSFER PUMPS
GPM
bar
HV 3007
P
IRRIGATION TRANSMISSION LINE TO LAKES

Moving Forward

- This paper presented the flexibility of district cooling systems in relation to the make-up and discharge water, making it capable of providing an optimized solution when combined with other applications.
- Combining DC with other applications requires collaborative efforts among DC Providers, Utility Agencies, Regulatory Agencies, & Law Makers.