

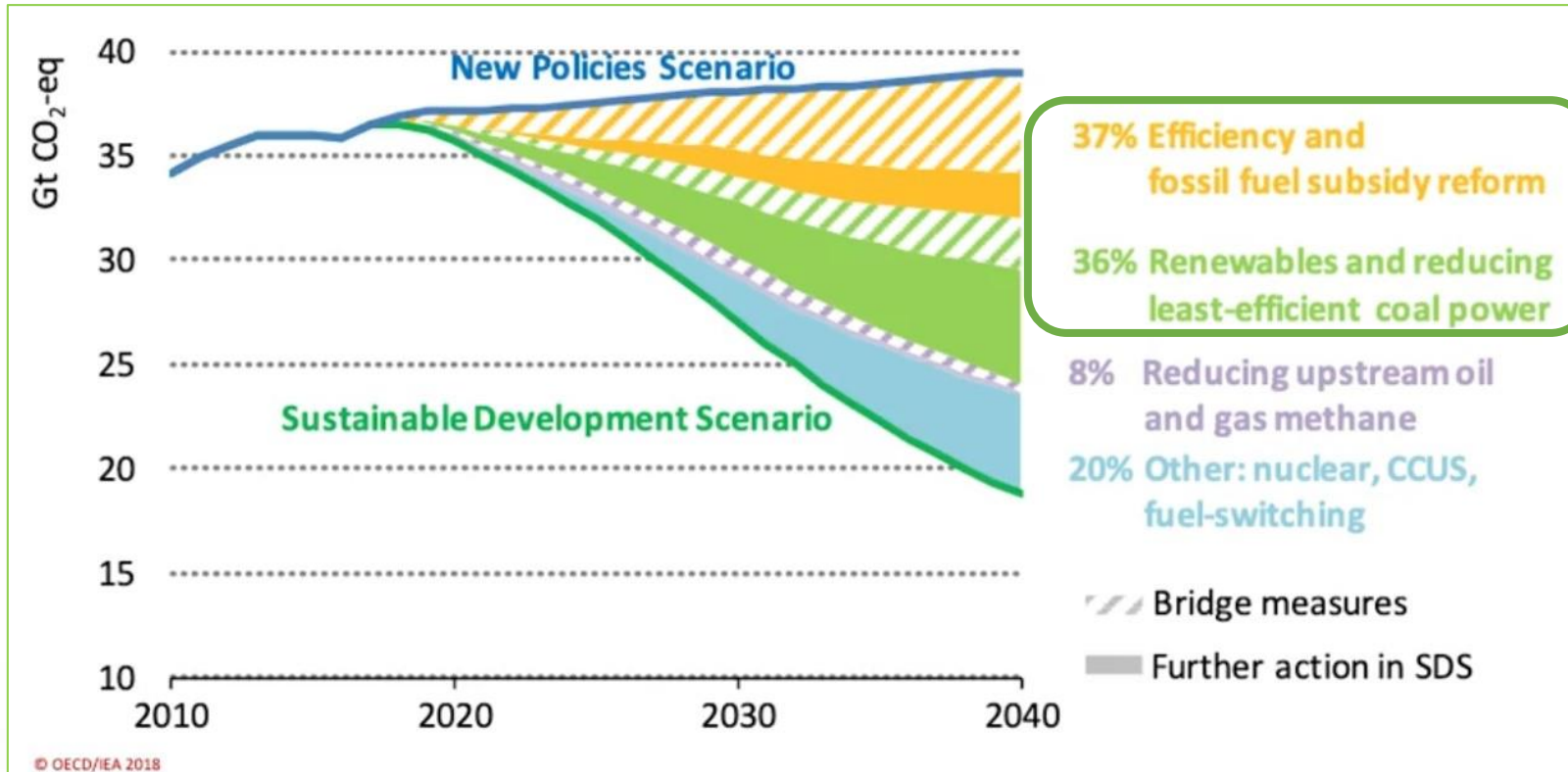
# District Cooling, Key Component in Sustainable District, Now and Prospects

Mr Foo Yang Kwang, Singapore District Cooling Pte Ltd

**APEC Workshop on District Cooling and/or Heating  
Systems (DCS)**

**EWG 08 2019S**

# Sustainable Development Goal



From IEA 2018 study, SDG can be achieved mainly through

- 1) Energy Efficiency
- 2) Renewables

District Cooling plays an important & useful role to support both initiatives

# DCS Viewed from Demand & Supply Side

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Demand -	Economic of Scale through aggregation
Comparative	Superior energy efficiency through integrated operation
Advantage	Enhanced reliability with more focused O&M and higher skill level O&M staff

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Demand -	Mainly implemented in new districts
Green Field &	
Brown Field	Challenging to implement in “silo” buildings in existing district. But an important next step to develop DCS as key building block of sustainable and smart energy district.

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Demand -	Proven in commercial set-up
Commercial &	
Residential	Residential is the next frontier for DCS. Useful to leverage on different day-night demand profiles to optimize asset utilisation

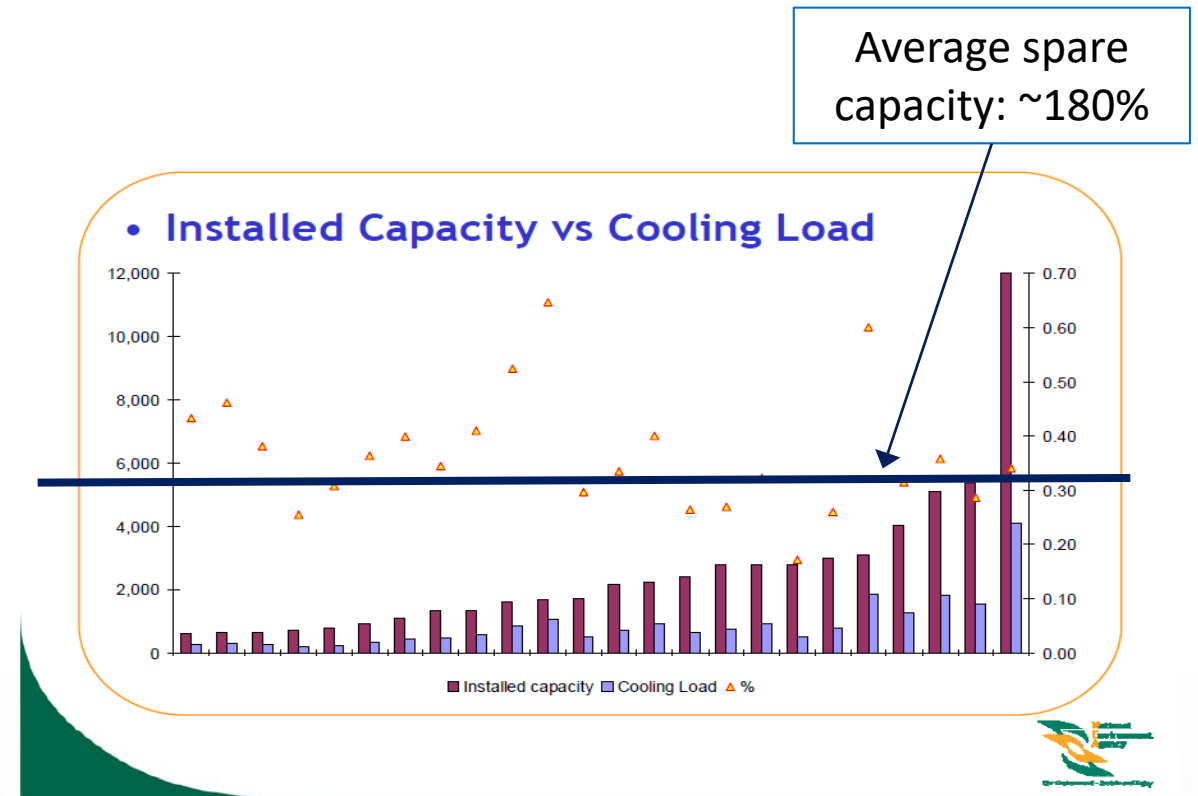
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Supply-	Thermal Energy Storage enhances Electricity Grid Stability
Incorporate	
Renewables	DCS is major energy usage system to provide stable base to incorporate renewables

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# Economic of Scale – Just Enough Resources to Meet Demand

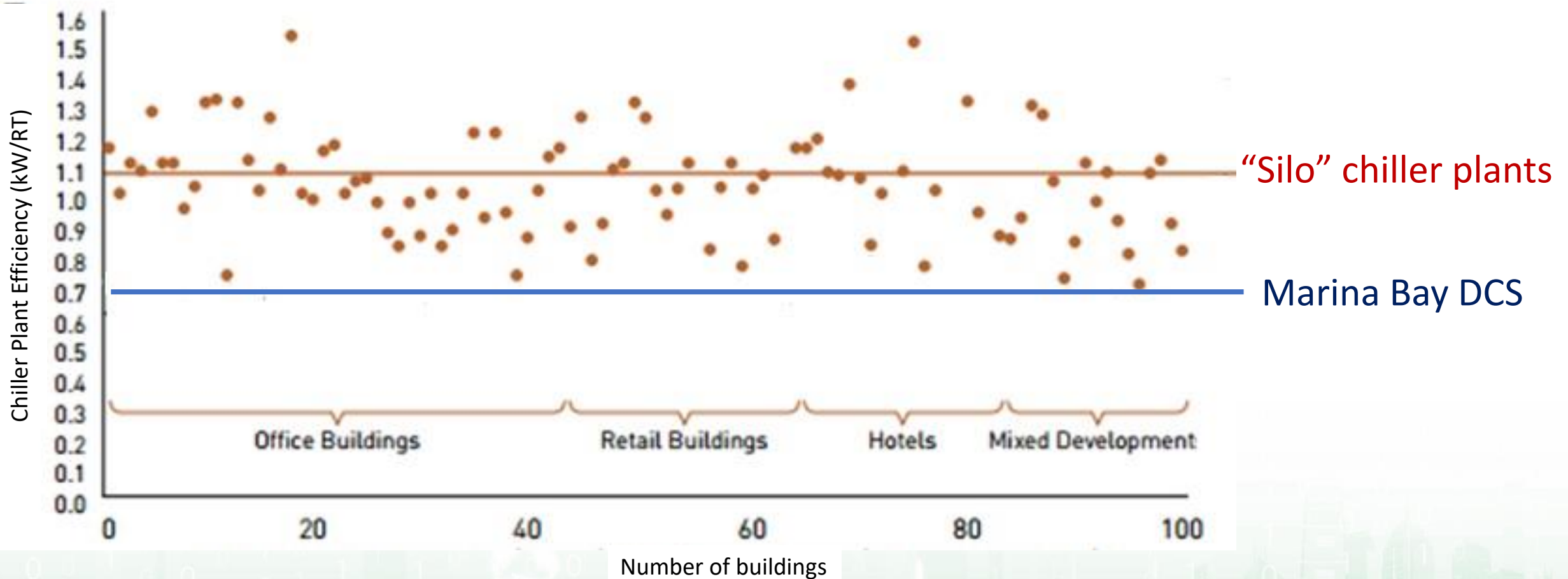
- 1) Minimise installation of unnecessary equipment hence economise resource used
- 2) Minimise refrigerant deployment hence reduces uncontrolled emission to atmosphere
- 3) Facilitate incorporation of promising sustainable technology due to scale.



\* NEA paper at APEC Workshop on Sustainable Energy Development in the Built Environment, 2009



# Superior Energy Efficiency via Integrated Operation



\* According to BCA Building Energy Benchmarking Report 2016

# Operation Efficiency through Focused Operations & Maintenance

Higher Skilled, Experienced & Fully Dedicated O&M Team

- Professional attention to details
- 24/7 Operation Team
- Daily review of equipment & system performance





# Green Field Implementation - Marina Bay DCS Overview

## Satellite Plant No1

at One Marina Boulevard

- Connected in **Feb 2013**
- Installed capacity: **10MWr**



## DCS Plant No2

at Marina Bay Sands

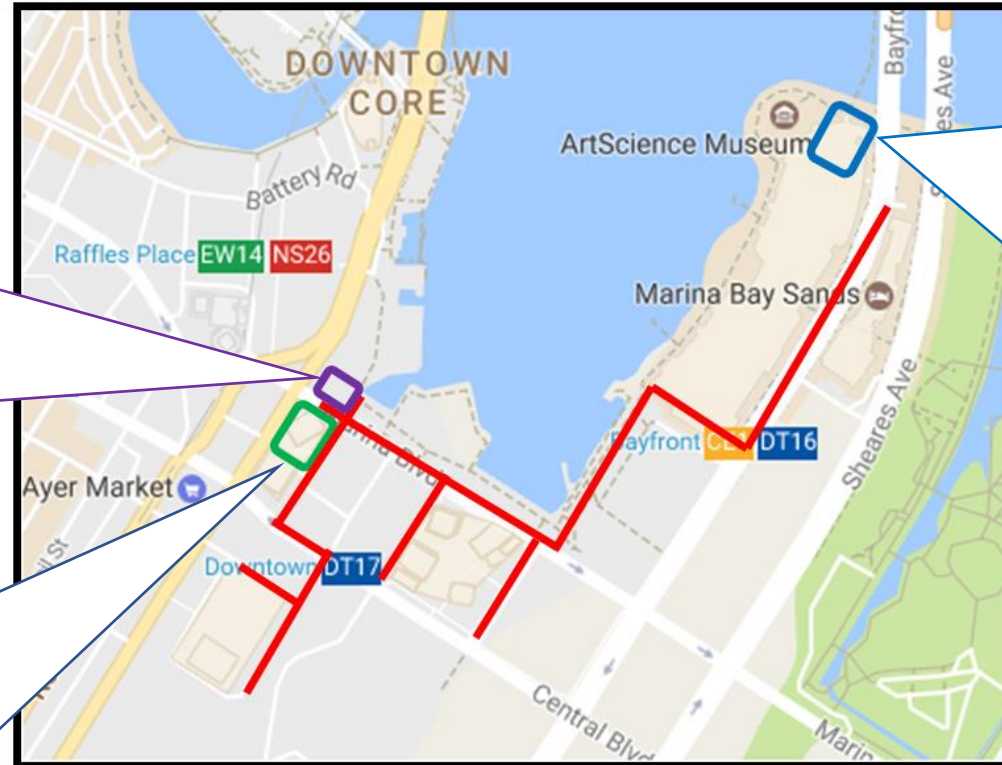
- Commissioned in **May 2010**
- Ultimate capacity: **180 MWr**
- Installed capacity: **120 MWr**



## DCS Plant No1

at One Raffles Quay

- Commissioned in **May 2006**
- Ultimate capacity: **157 MWr**
- Installed capacity: **97 MWr**



Pipe Network in Common Services Tunnel



# Unique DCS Regulatory Model at Marina Bay



## Master plan

- > 8 million m<sup>2</sup> Gross Floor Area
- > 900MWr Cooling Load
- 4-5 District Cooling Plants



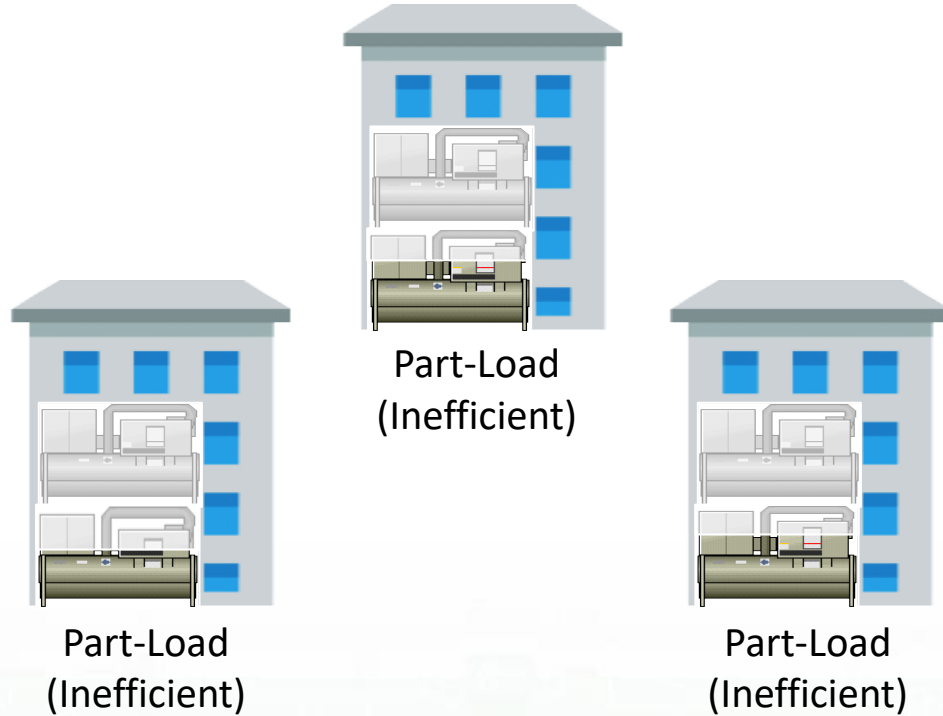
## Framework

- Co-locate DCS plants at selected large-scale developments
- Mandated utility service
- DCS Tariff regulated by Authority (EMA)
  - Ensure full transparencies of costs, responsiveness and availability
- DCS service pricing to be lower than the economic cost of in-building chilled water production



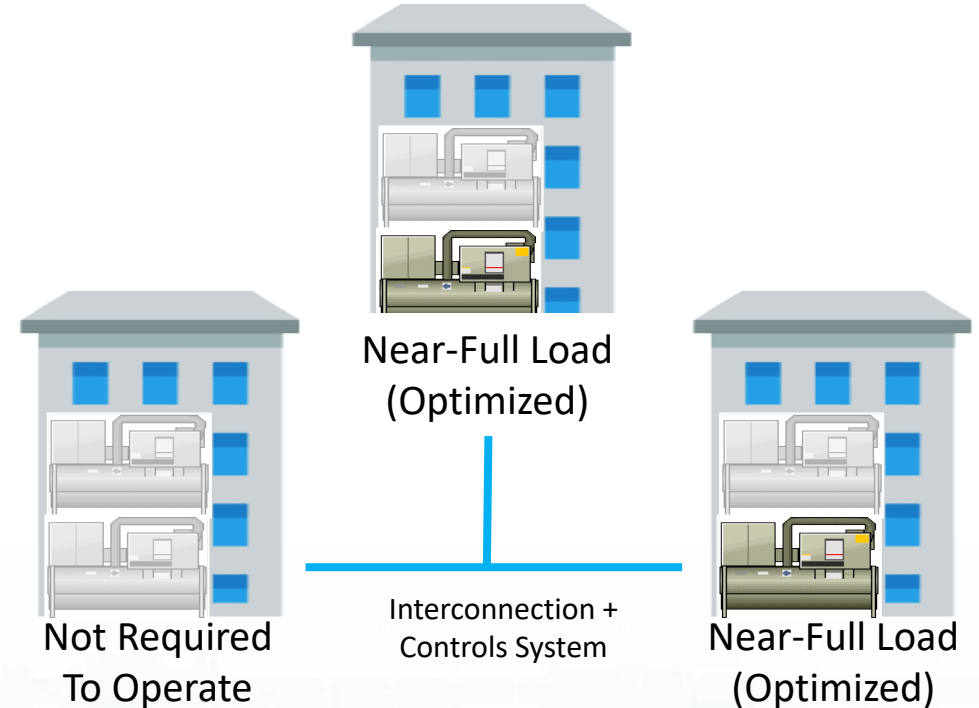
# Brown Field DCS – Interconnect Chiller Plants with Network

## “Silo” Chiller Plant in Buildings



- Partial Loading Results in Inefficient Systems
- Standby Capacity Takes Over while Inefficiency Remains
- If entire building trips, no cooling provided

## Multi-point Injection District Cooling (Brown Field DCS)



- Systems optimized to provide most efficient configuration
- Network Resiliency should any point of failure occurs

# Beyond Commercial – Centralised Cooling for Residential

## Tengah Residential District



220 Residential Blocks, Total 22,400 homes  
(Developed by: Housing Development Board, Singapore)

### Traditional Arrangement Conventional Split Unit



Condensing Unit at Air Con Ledge

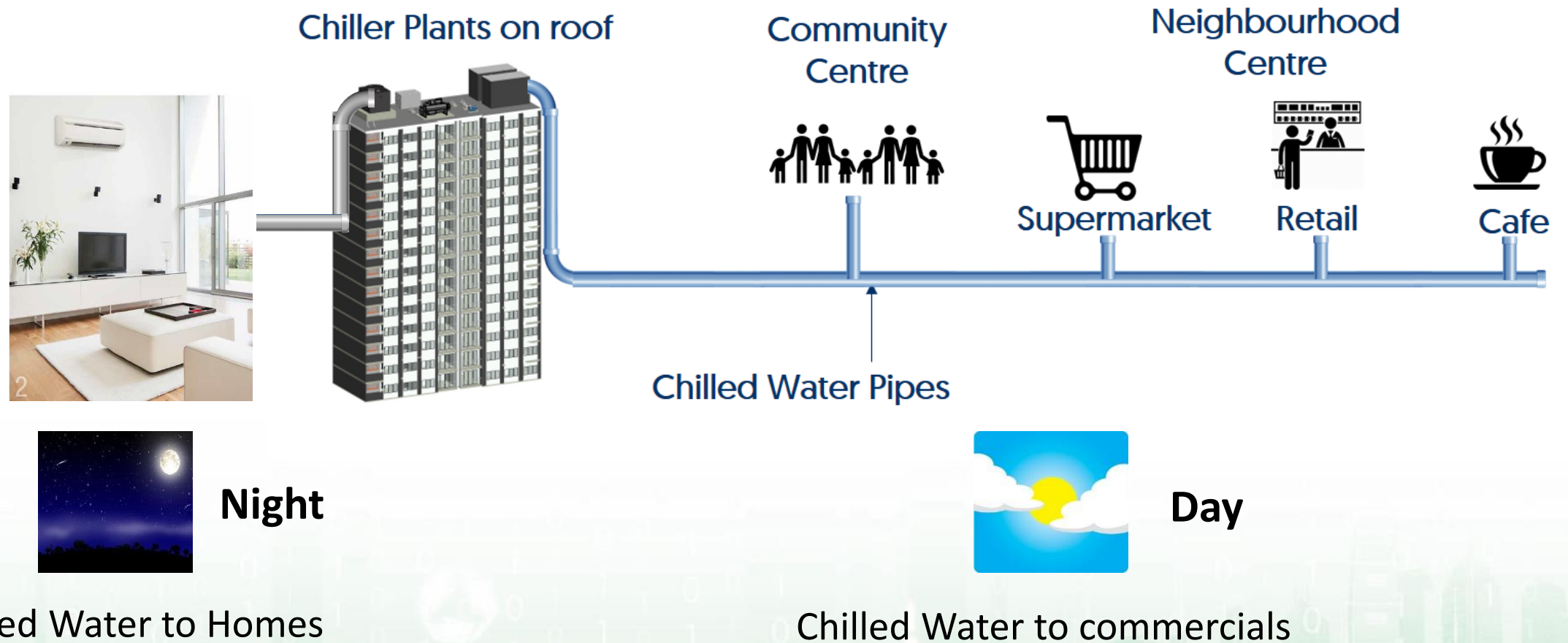


### New Concept Centralised Cooling System

Chilled Water Supply and Return Pipe



# Residential District - Centralised Cooling Concept





# Enhance Electricity Grid Stability

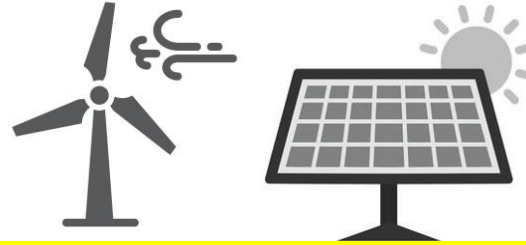
## Supply Side Solution

Power plant operate “peaking” plant which is less efficient to address the instability.



Power Plant

## Renewable Energy

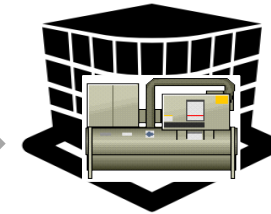


Introduces instability to electricity grid

Possible Counter Measures

## Demand Side Solution

Authority to implement Interruptible Load or Demand Response measure to address instability



DCS with Thermal Energy Storage (TES)

- Part of DCS operation
- Cost effective
- Curtail 16MWeh per storage tank (10mx20mx12mH).



Batteries

- Not yet Cost effective
- Curtail 0.4MWeh per container (2.3mx5.4mx2.2mH)



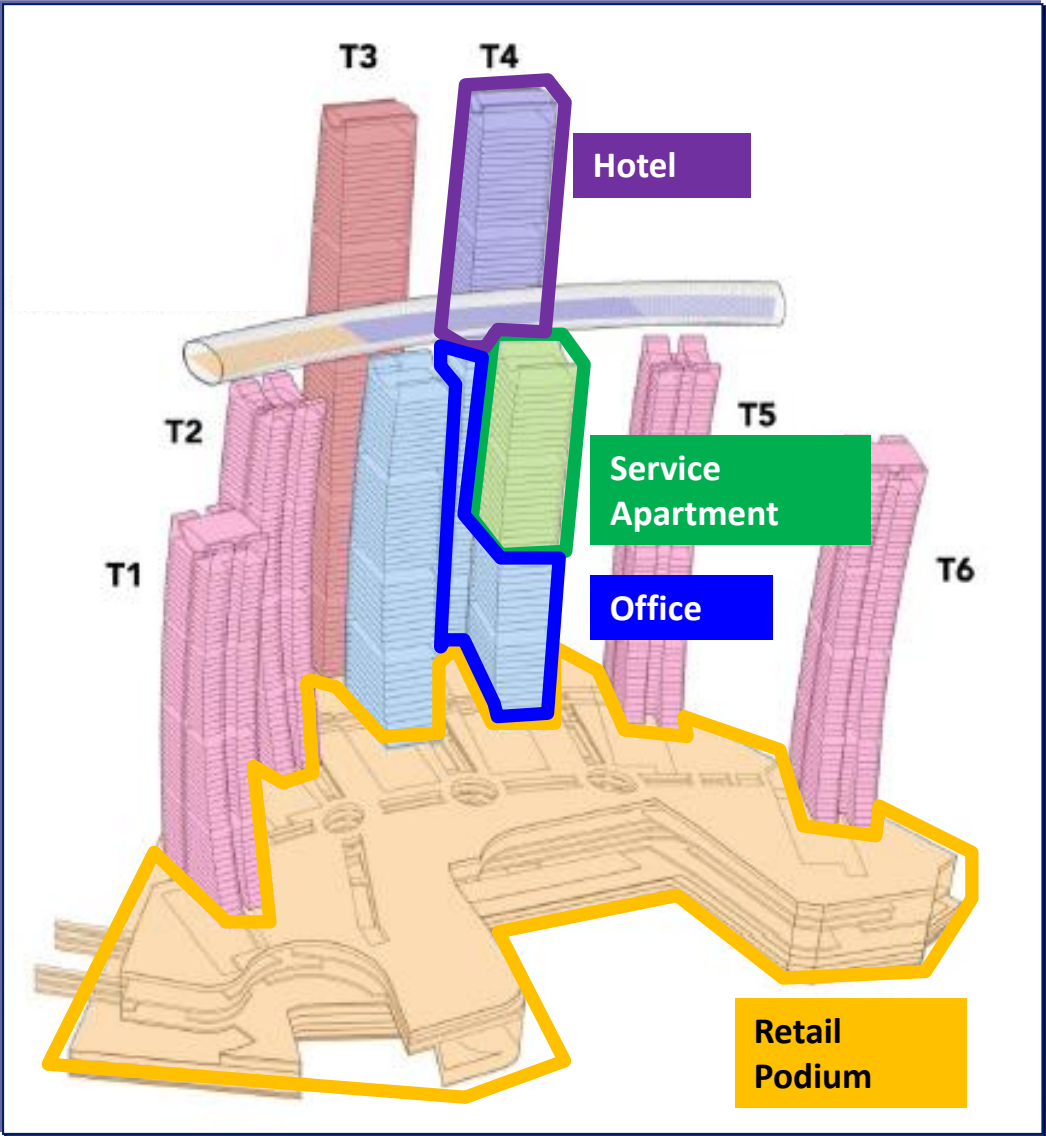
Regulator

# Beyond Singapore – DCS for China Development

Chong Qing Raffles City Chao Tian Men  
重庆朝天门



~380,000m<sup>2</sup> Gross Floor Area  
~50MWr Cooling Load  
2 District Cooling Plants



# Questions & Answers