Development of a Demand Response Programme to Resolve Local Network Congestion

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Company Overview

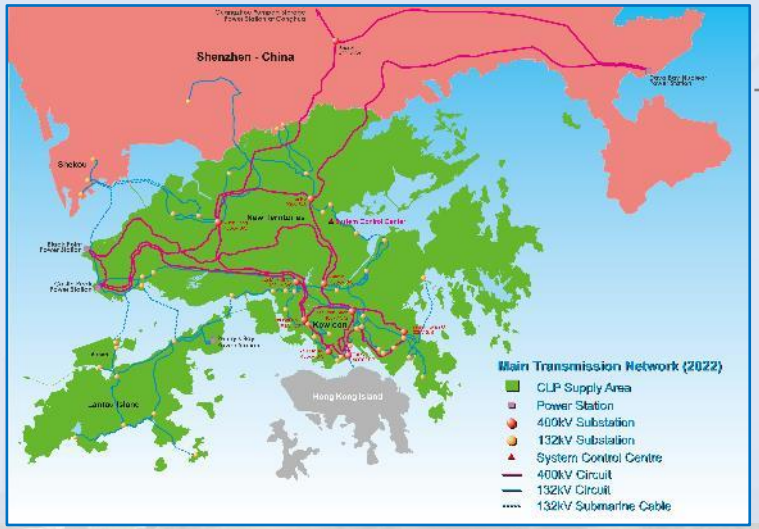
CLP Holdings invest in five Asia-Pacific Market – one of the largest investor-owned power businesses in Asia-Pacific

Power Generation
(Natural gas, Nuclear Coal, Renewable Energy)

Power Systems
(Transmission & Distribution)

Customer Success and Experience
(Retail & Customer Services)

CLP Power Hong Kong



More than **120** Years

Supplying electricity to

> 2.77 Million customers

=> 80% Population in Hong Kong

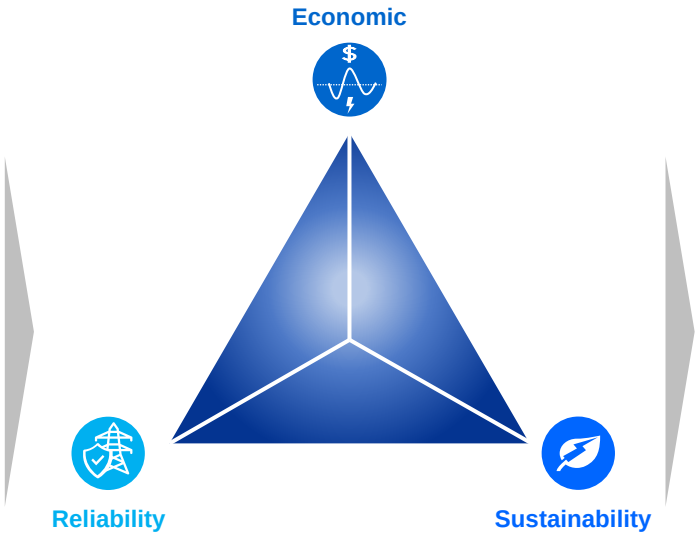
World-class Supply Reliability

99.999%

Challenges and Opportunities

Decarbonisation

Digitalisation



Challenges:

Supply side

- The future integration of additional nuclear and intermittent renewable energy sources may present challenges to system flexibility.

Demand side

- The widespread adoption of EVs may present challenges to the current power infrastructure, potentially leading to local network constraints.

Opportunities:

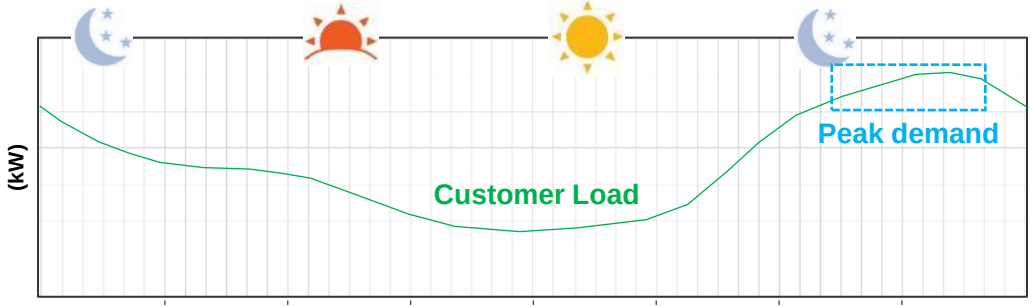
- The successful rollout of smart meters and communication technologies enables seamless two-way communication between customers and the utility

Leveraging demand-side management to address these challenges economically, such as incentive-based demand response programmes

What is Demand Response (DR)?

Incentive-based demand response programme

Power utility companies offer incentives to customers when they reduce their energy consumption during peak demand hours.



Cost Savings

Consumers can achieve significant **energy cost savings** and **earn incentives** by participating in DR programmes.

Environmental Impact

By minimising the need for additional power generation during peak periods, these programmes help **reduce greenhouse gas emissions** and contribute to a cleaner, greener environment.

Localised Demand Response (LDR) - Introduction

Pain-points

Impacts of **localised network congestion**

- **Potential unplanned outages** due to overload
- Challenge to optimise our services to better **accommodate new customers**

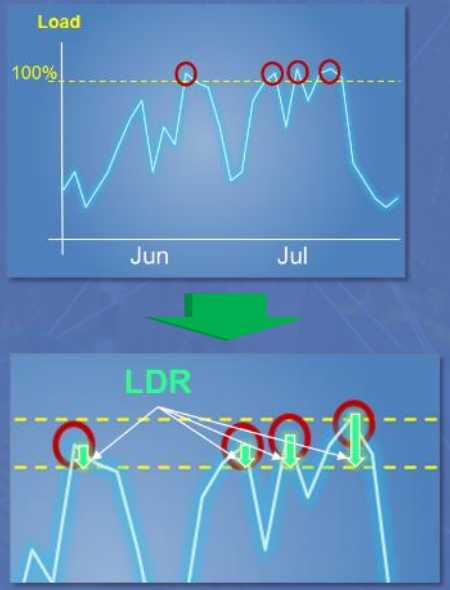
Traditional Solution

Limitation of **"Capacity Reinforcement"** (e.g. Grid Upgrade / Load Transfer)

- **Lengthy implementation**
- **Not cost-effective** to reinforce for temporary peak

Localised Demand Response

LDR to resolve temporary peak



LDR Proof of Concept (PoC) Objectives

Influence

Impacts

Imbalance of supply & demand in local networks due to anticipated and unanticipated variability, **impacts the grid stability, supply reliability, and electricity supplies to Customers**

Large capital investment to deploy supply side solution (e.g. **permanent grid reinforcement**) to meet **short duration of peak demand**

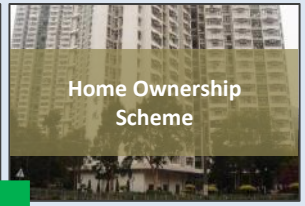
"Localised Demand Response (LDR)"

Objective: Resolve local network issues by activating **Demand Response(DR)** to selected local networks

PoC Arrangement

- Customer Incentive — Domeo Point (CLP loyalty point)
- DR Period — Evening peak in summer

Customer Segments



Goals

- Acquire **customer behavioural data** under frequent Demand Response events
- Evaluate the **technical effectiveness** to resolve distribution constraint by Demand Response

LDR Roadmap

Post Implementation Review

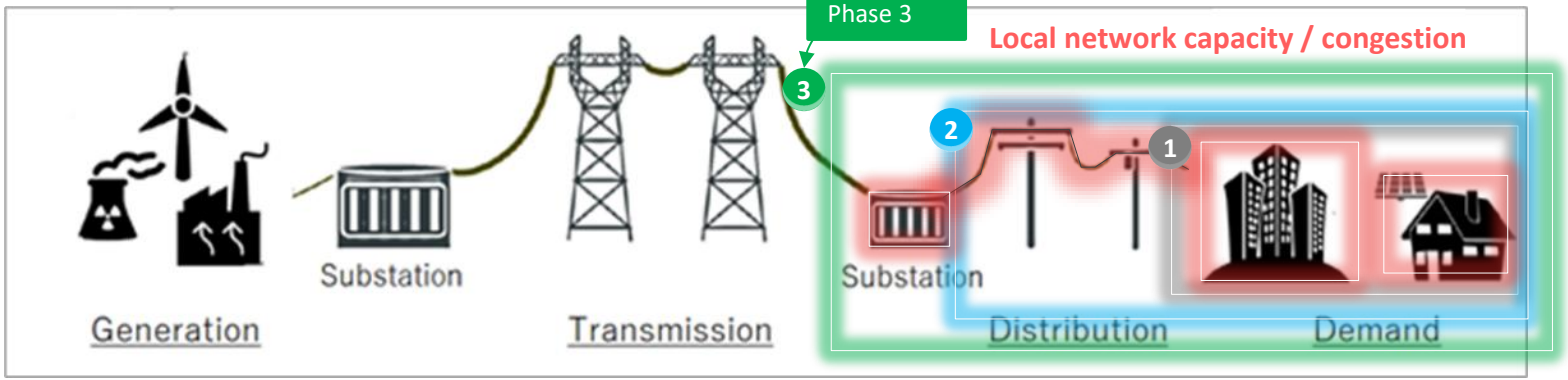
Post Implementation Review

Post Implementation Review

Phase 1 – 2021 → **Phase 2 – 2022** → **Phase 3 – 2023+**

Scope

Phase 1 – 2021	Phase 2 – 2022	Phase 3 – 2023+
LV network with capacity or congestion issues	**11kV ring network** with capacity or congestion issues	**132kV/11kV transformer at primary substation** with capacity or congestion issue



Overview of LDR programme

Customer Engagement

27,000 customers from

- 132kV network
- 11kV & LV network

Customer Type

- Residential

Customer Communication

- 4-6 hours notification prior to the DR event

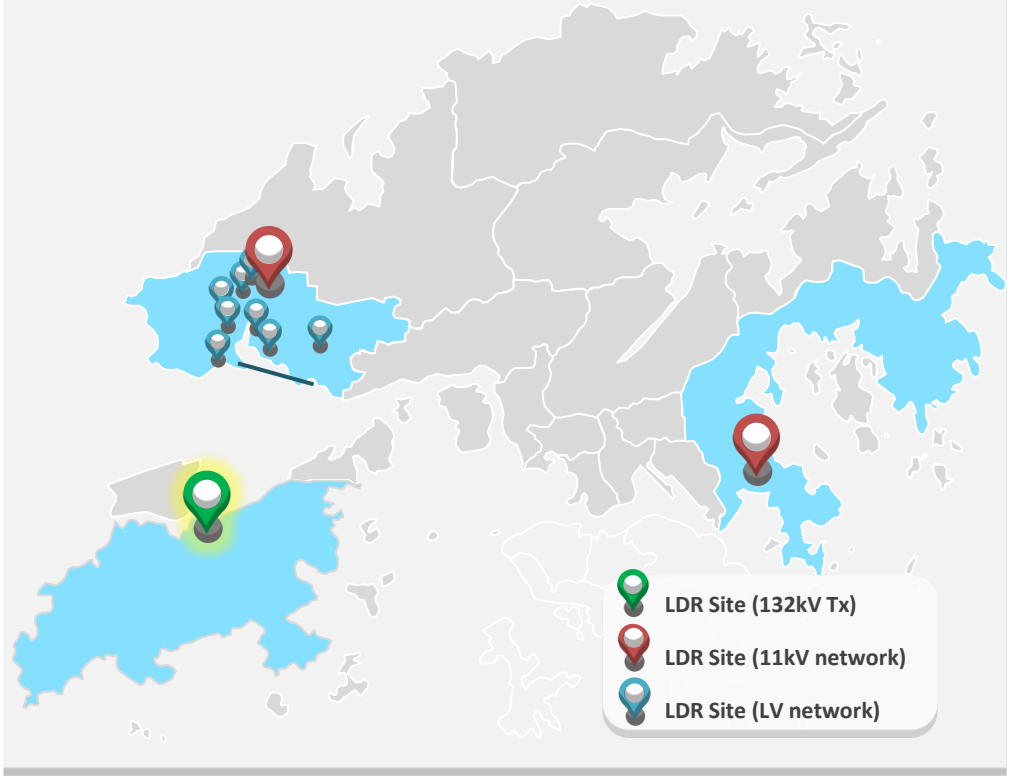
DR Event Duration

- 3 hour

Evaluate

- Maximum demand cut at 132/11/LV sites
- % Customer achieved Energy Saving (effective participation)

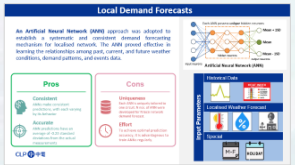
Location of LDR Sites



LDR - Operation

Retrieve data and process **Local Demand Forecast**

- Localised circuit load
- Historical regional weather
- Hourly forecast regional weather

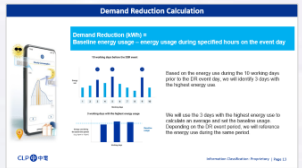


Make LDR event recommendation based on forecast results

Notify customers to get ready for the DR event

Customer participation

Measure the demand cut and distribute incentives to customer for their contribution



LDR Results and Way Forward

RESIDENTIAL SEGMENT

highly responsive to

LOCAL DEMAND RESPONSE

Participants Engaged

27k

Achieved Saving

18.4k (68%)

LV

11kV

132/11kV

Demand Reduction Performance

Domeo point

Incentive

Way Forward

- Explore more use-case for LDR
- Evaluate the effectives of LDR with shorter notification

Thank You

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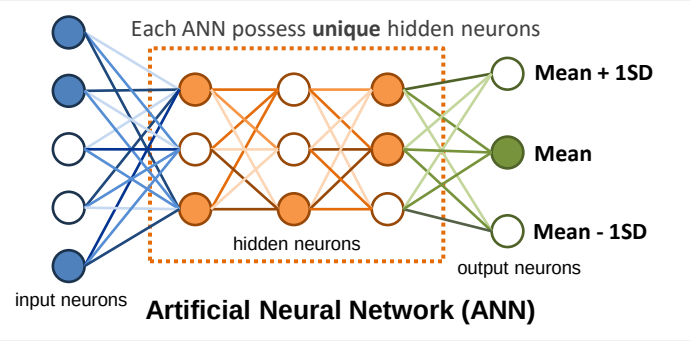
Local Demand Forecasts

An Artificial Neural Network (ANN) approach was adopted to establish a systematic and consistent demand forecasting mechanism for localised network. The ANN proved effective in learning the relationships among past, current, and future weather conditions, demand patterns, and events data.



Pros

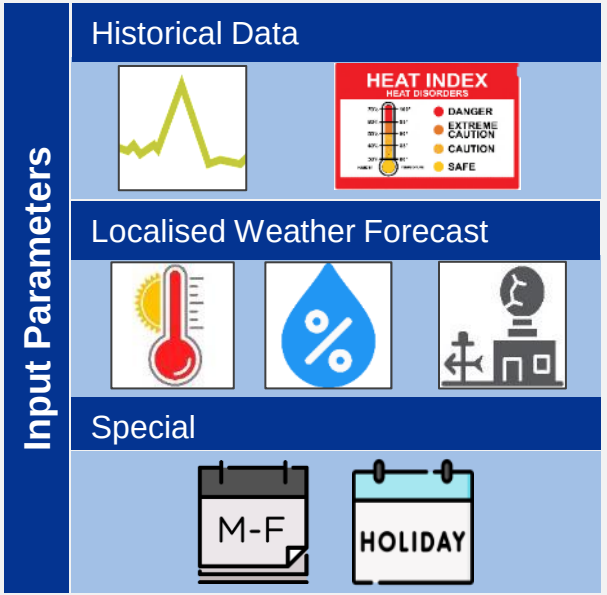
Consistent
ANNs make consistent predictions, with each varying by its behavior

Accurate
ANN predictions have an average of -0.23 standard deviations from the actual measurements

Cons

Uniqueness
Each ANN is uniquely tailored to one circuit. N nos. of ANN were developed for N local network demand forecast.

Effort
To achieve optimal prediction accuracy, it is advantageous to train ANNs regularly.



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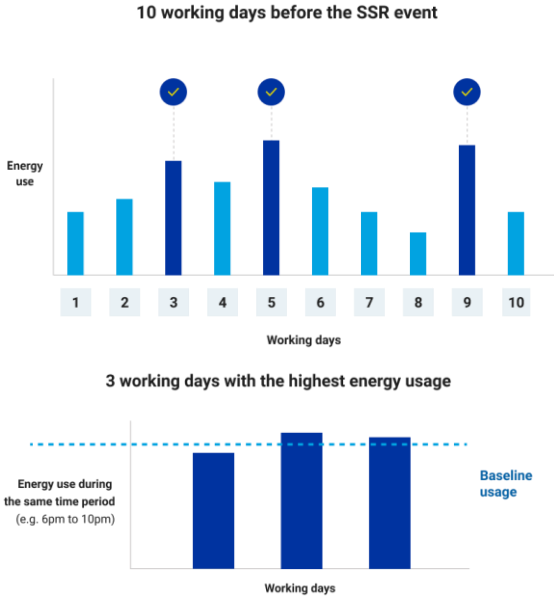
Demand Reduction Calculation

Demand Reduction (kWh) =
Baseline energy usage – energy usage during specified hours on the event day



Based on the energy use during the 10 working days prior to the DR event day, we will identify 3 days with the highest energy use.

We will use the 3 days with the highest energy use to calculate an average and set the baseline usage. Depending on the DR event period, we will reference the energy use during the same period.