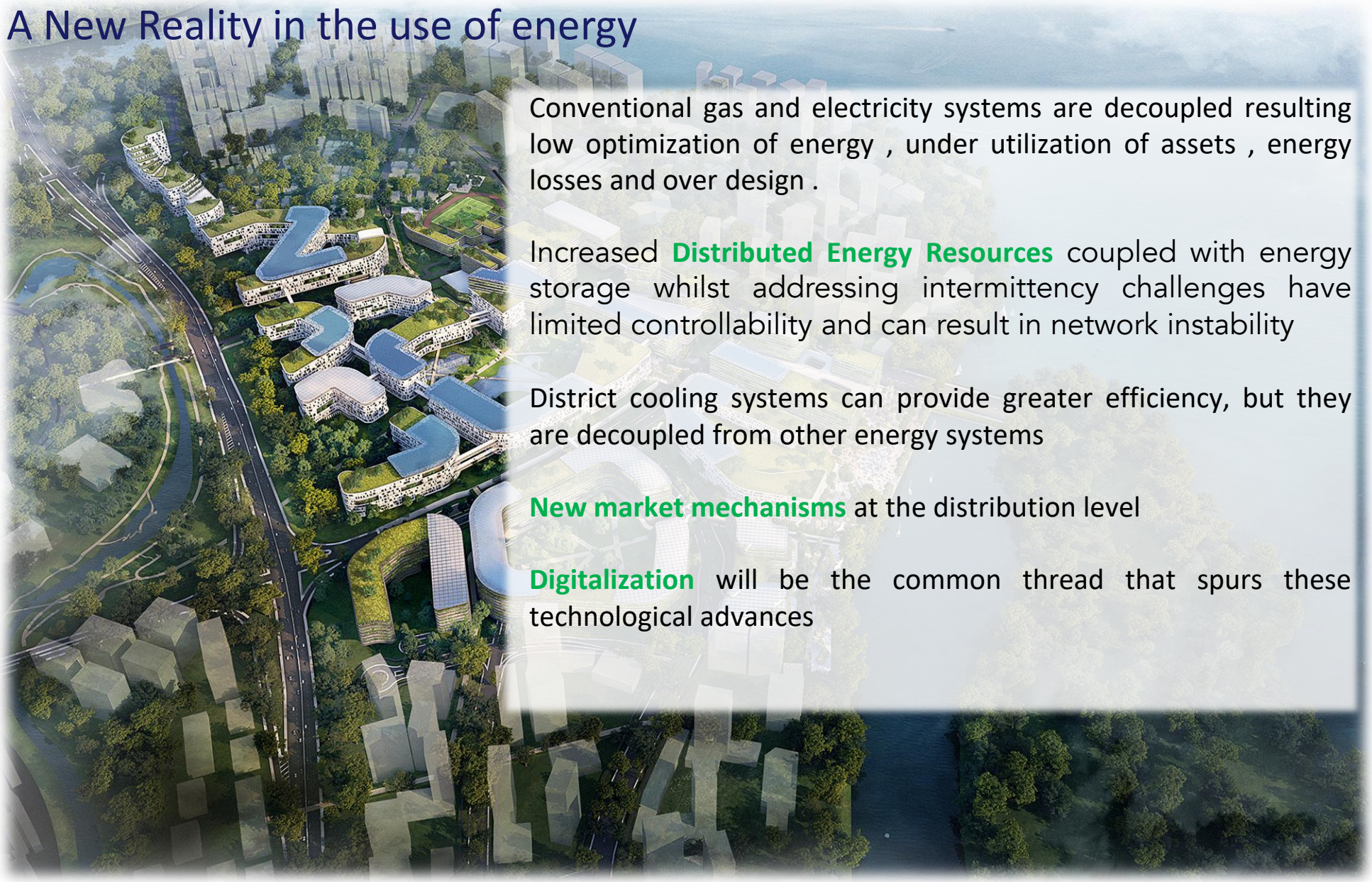
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Energy Research Institute @ NTU

REDUCING CARBON FOOTPRINT AND ENERGY BILL IN A DISTRICT

CHERIF ASSAF -PROGRAM DIRECTOR-ERI@N

A New Reality in the use of energy



Conventional gas and electricity systems are decoupled resulting low optimization of energy , under utilization of assets , energy losses and over design .

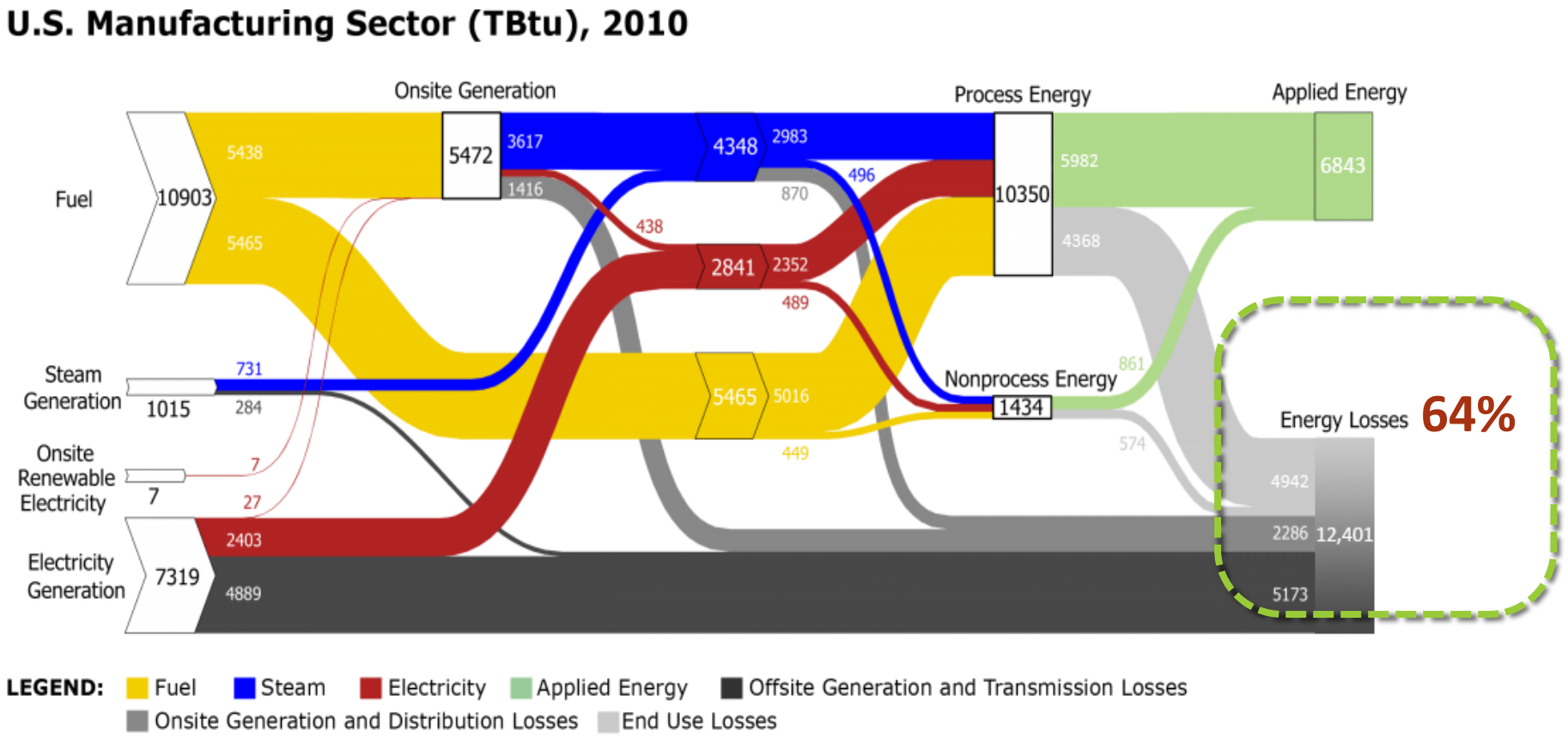
Increased **Distributed Energy Resources** coupled with energy storage whilst addressing intermittency challenges have limited controllability and can result in network instability

District cooling systems can provide greater efficiency, but they are decoupled from other energy systems

New market mechanisms at the distribution level

Digitalization will be the common thread that spurs these technological advances

64% energy losses typically seen in manufacturing sector

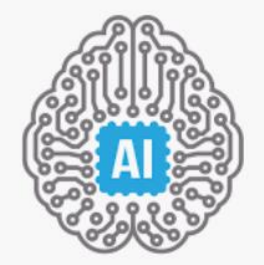


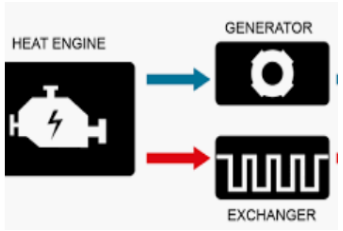
Source of electricity: grid, local-generation

Losses: Process Energy Loss: ~45%, Electricity Generation

Opportunity: Energy recovery processes

Our Challenges : introducing SMES (Smart Multi Energy System)





Development and demonstration of an ***integrated Multi Energy Management & Information System*** at a commercial ***industrial*** site with:

- Seamless integration of Energy Generation, Storage, & Rational End-use
- Integration of Electric, Thermal, and Gas networks
- Real-time interaction with Energy Market

NTU  JTC

To achieve substantial ***energy*** (at least 20%) and ***cost savings*** (at least 30%) resulting in at least 20% **CO2 emission reduction**.

Multi purpose port : 155 Ha
40,000 Vessels x yr.

Electricity requirements :
10MW at peak through PV which represents 60% of the Harbour power requirements

Jurong Port

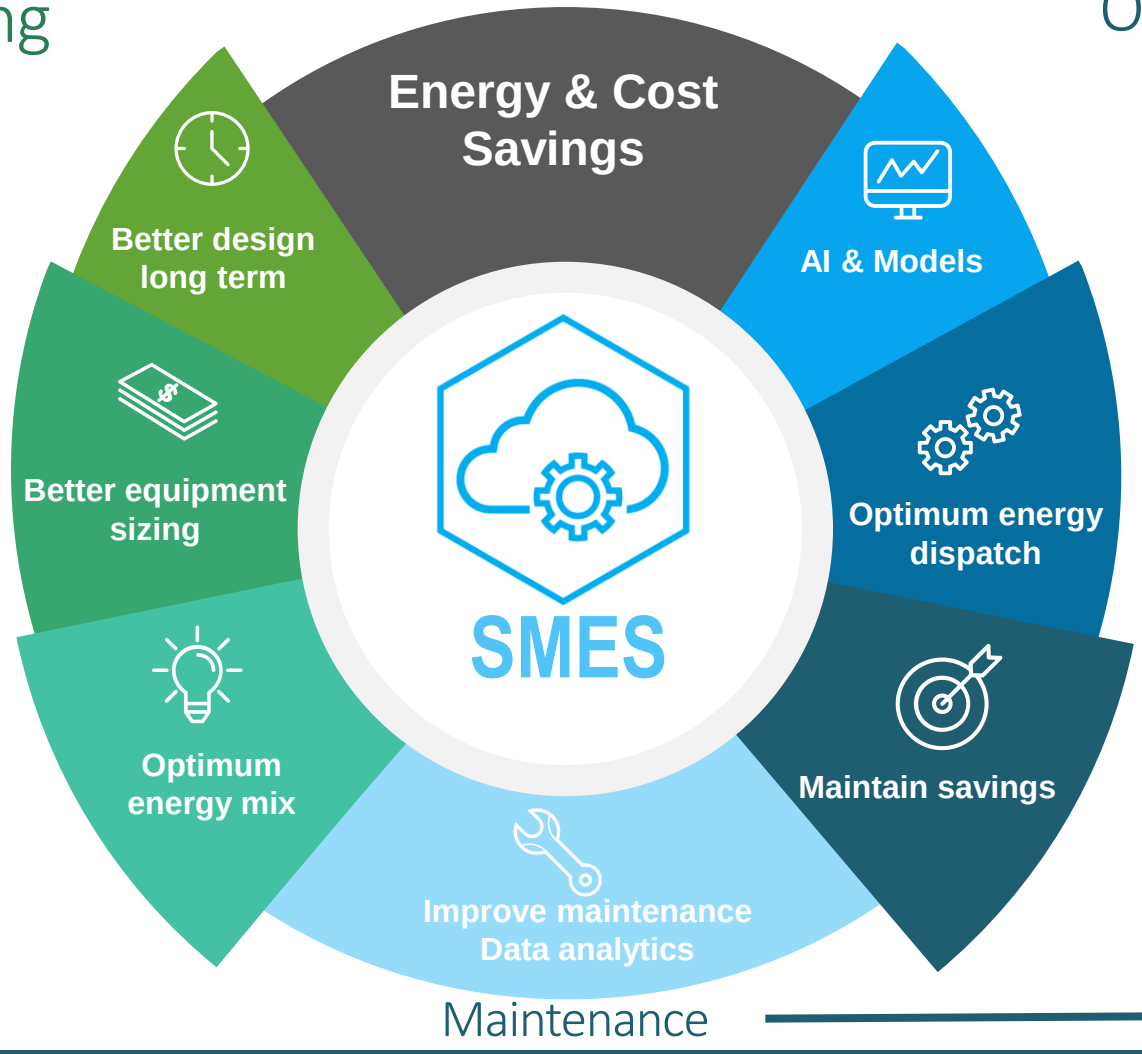
SMES is NOT just a software, it’s a solution

Planning

SMES

Optimum Planning Tool (OPT)

Optimize CAPEX



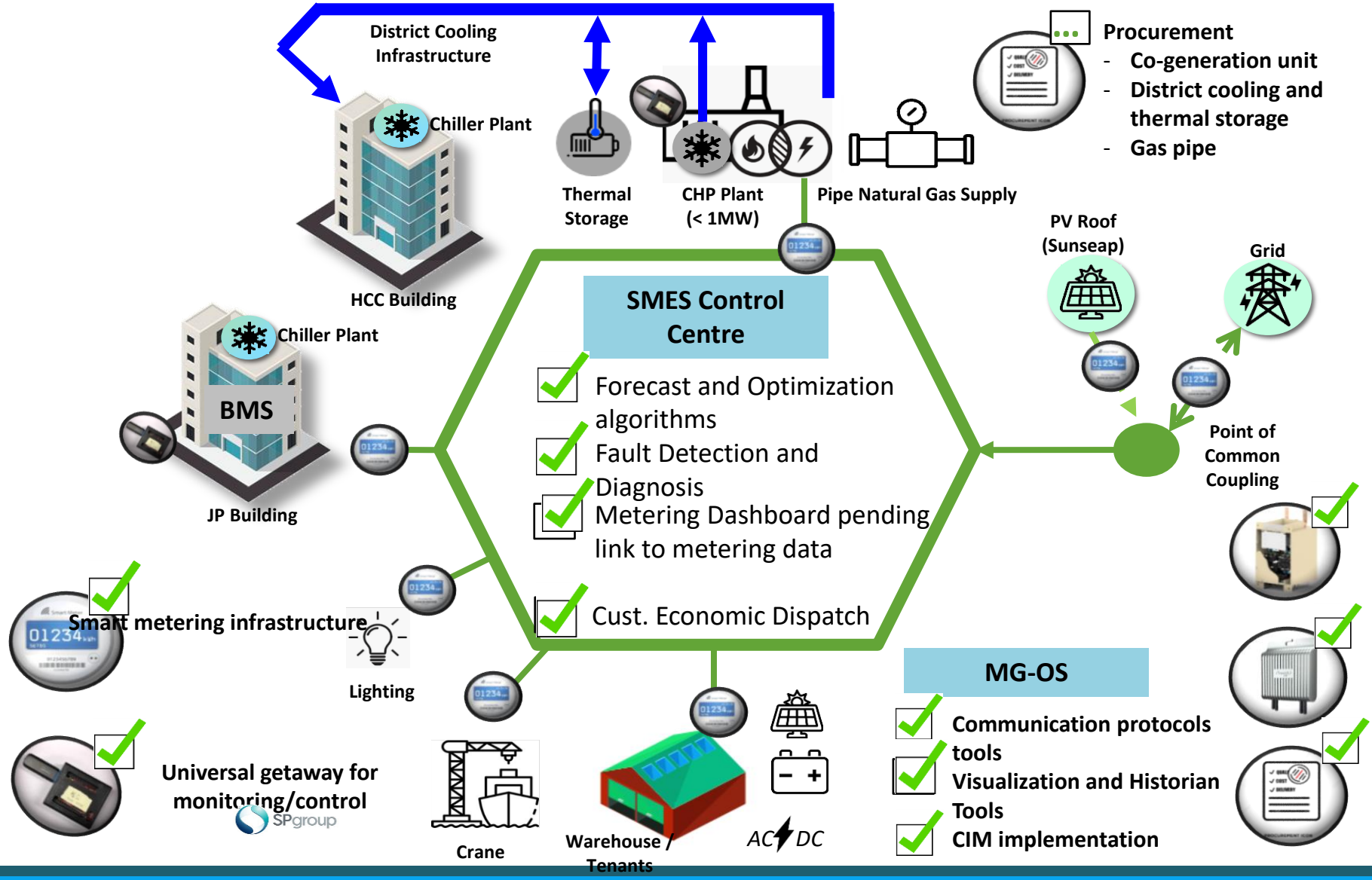
Operation

SMES

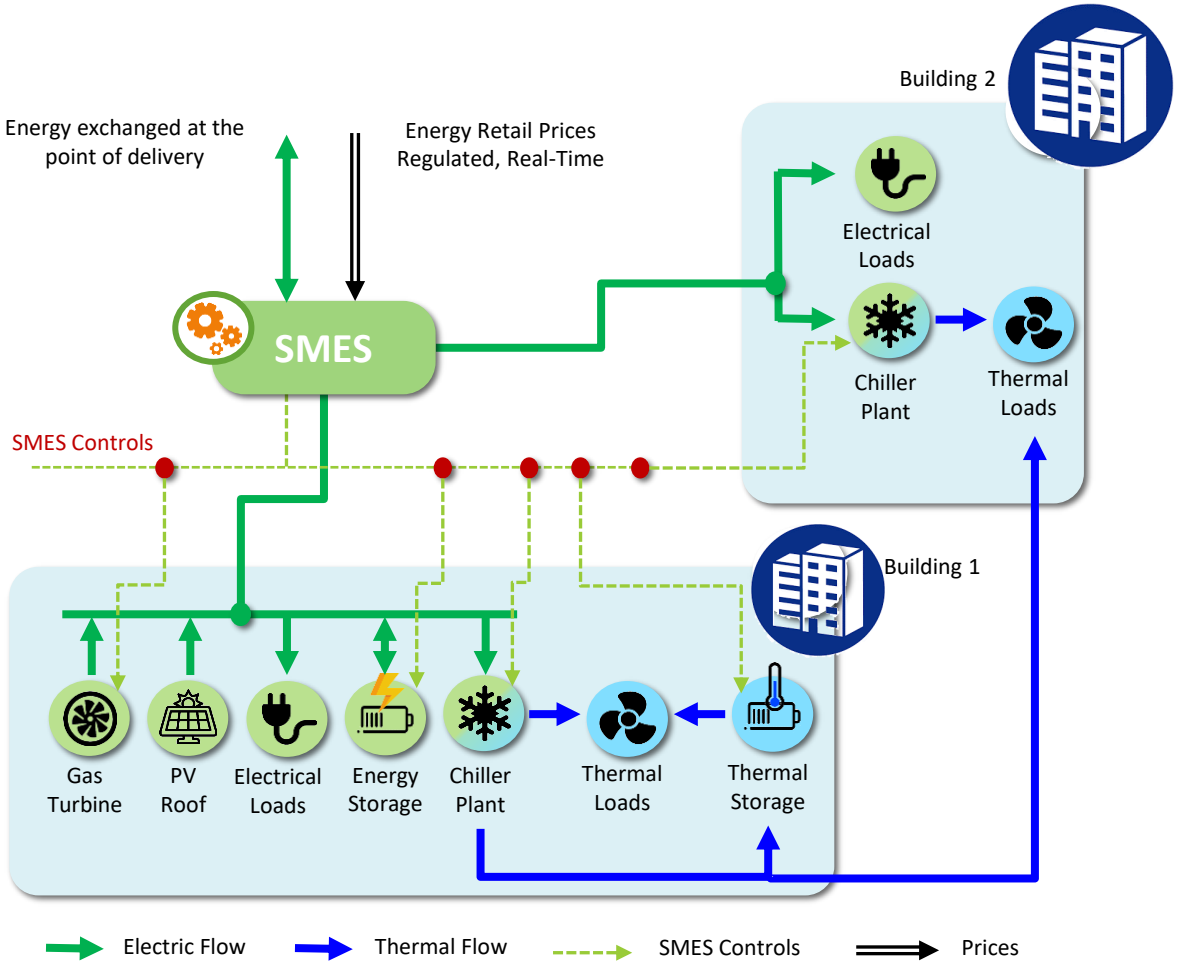
Cloud Platform

Optimize OPEX

JURONG PORT DEPLOYMENT



SMES Operation platform : the heart of the system



Features :

Economic dispatch

Electric/thermal management

Metering

Tariff management

Fault detection and diagnostic

Strategy :

Forecasts for generation, consumption and prices.

Economic **energy dispatch** (30min) Energy arbitrage, peak shaving.

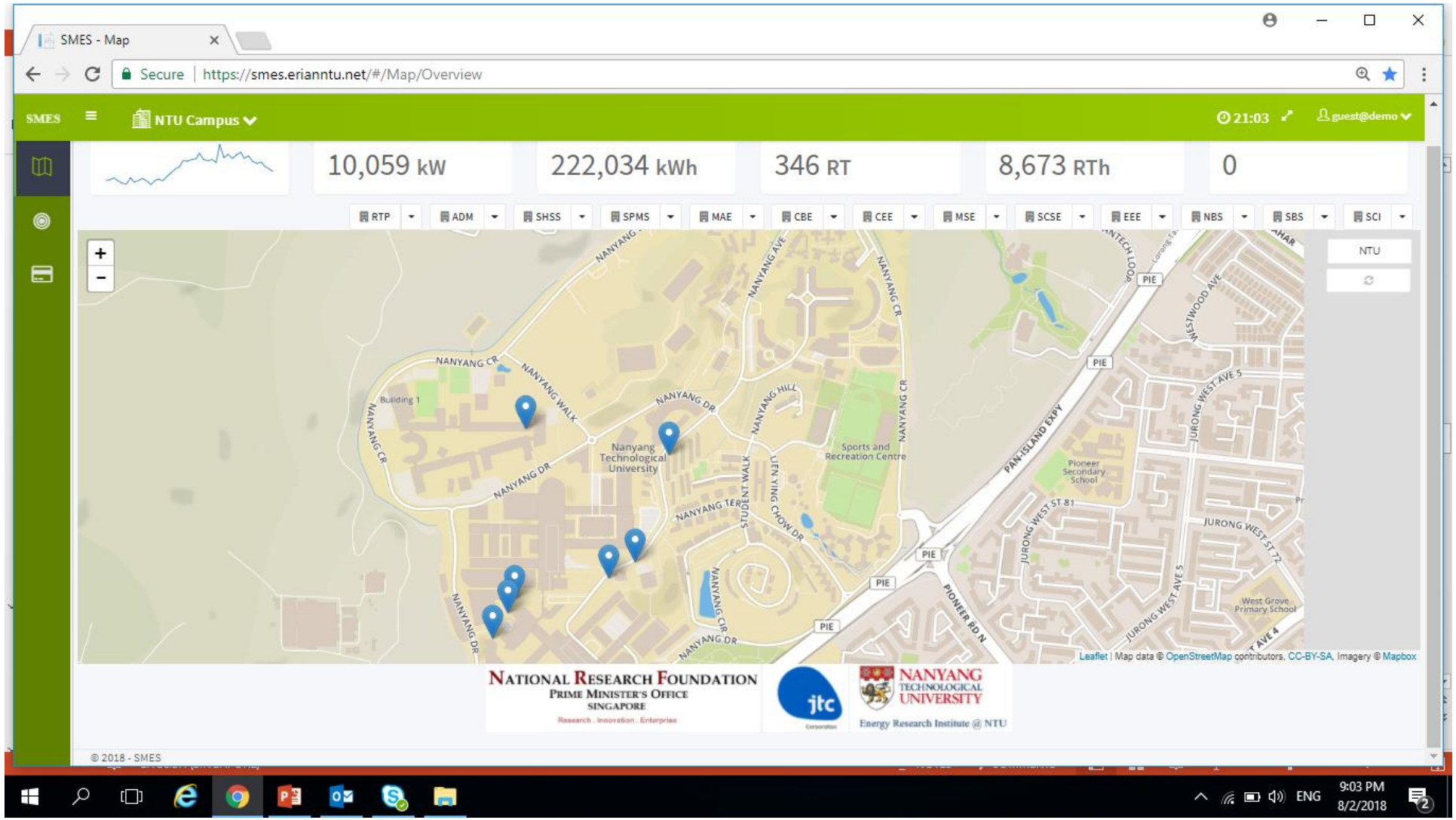
Model Predictive Control, Rolling Time Horizon.

Rule based engine for FDD

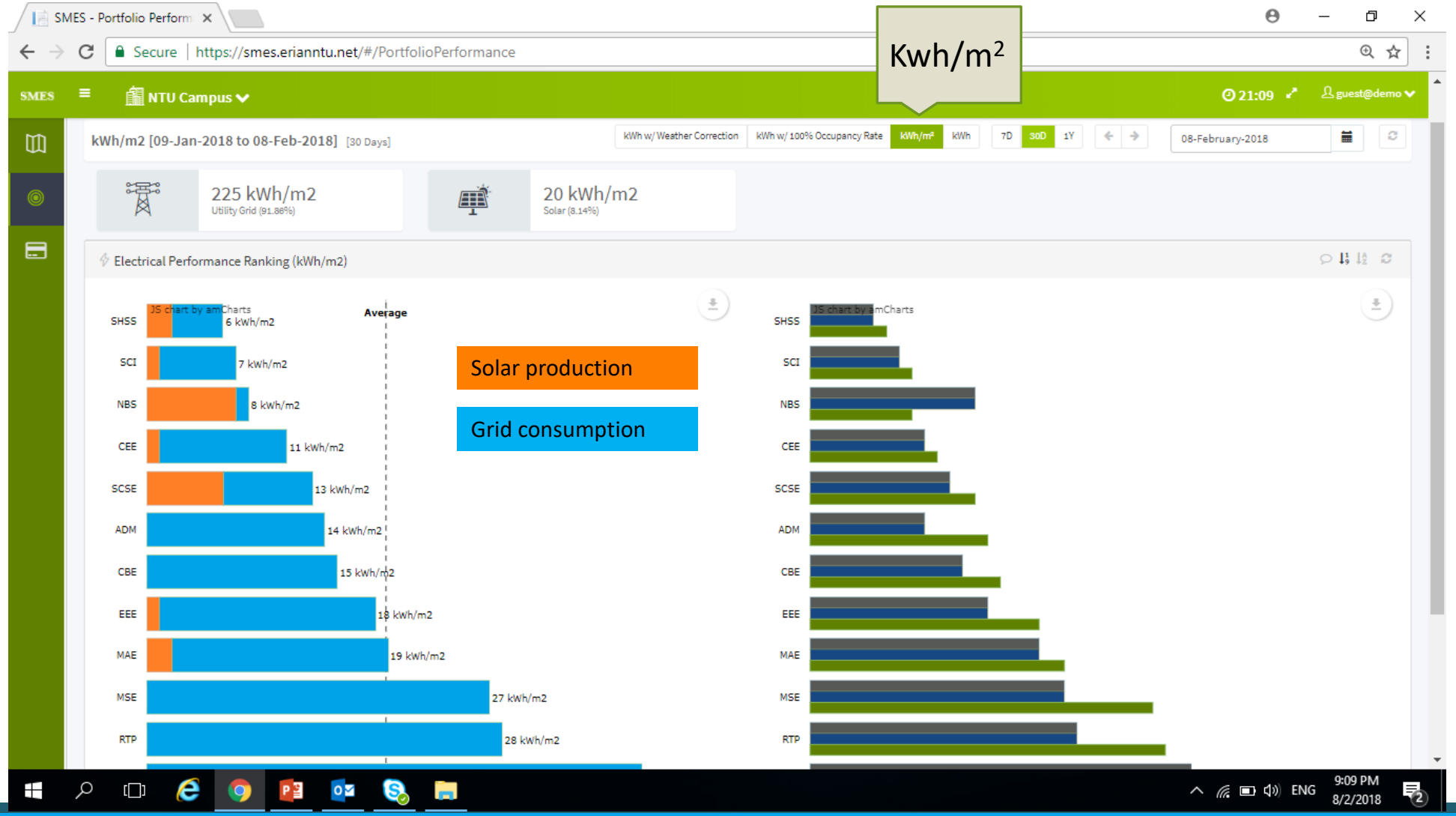
Main Block Functions

- Data acquisition : field gateway
- Data Storage : SQL Server
- Data Analysis : Artificial Intelligence
- Optimization : Mathematical Prog.
- User Interface : Web Based

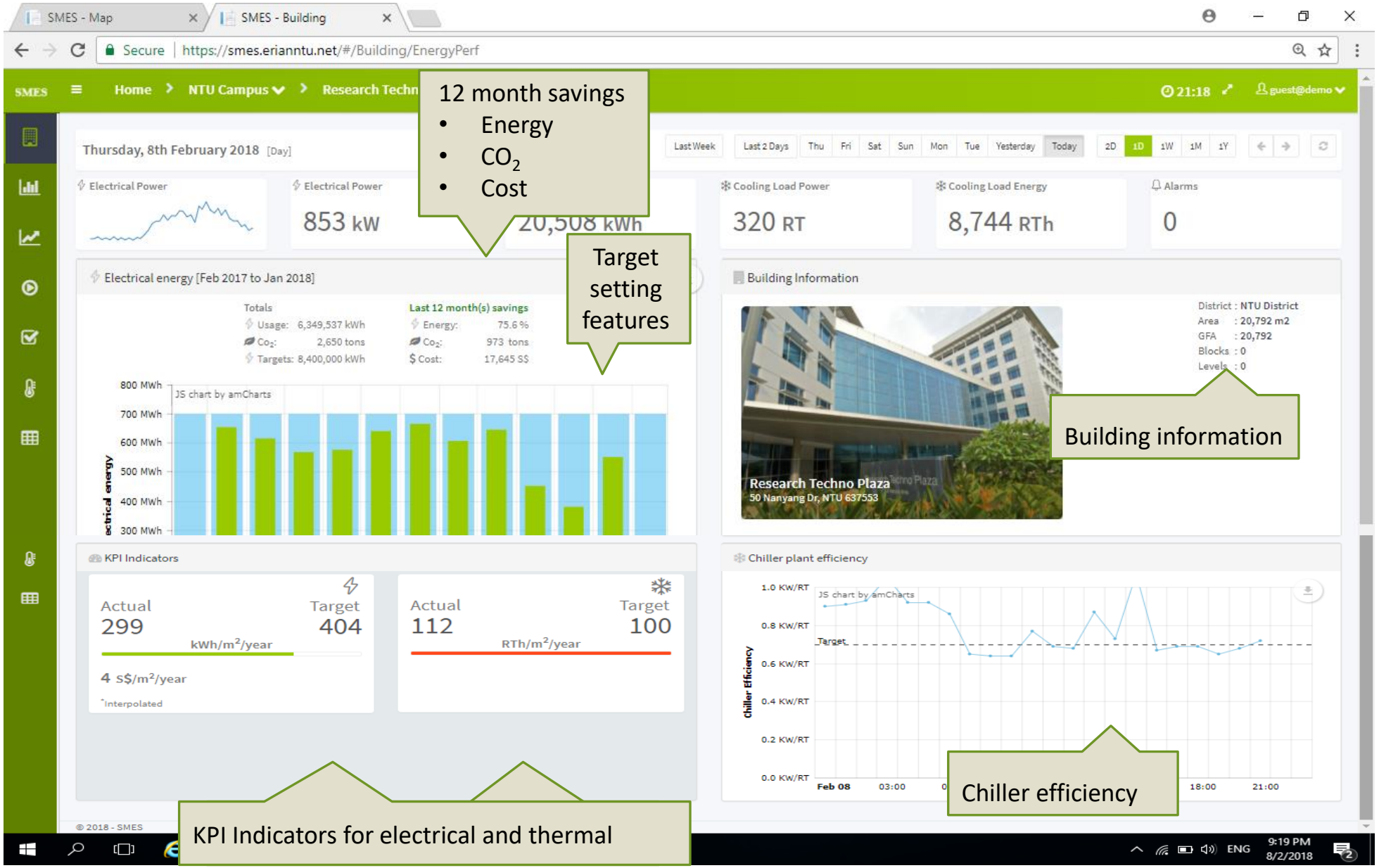
We monitor energy consumption from 13 buildings on NTU campus in real time



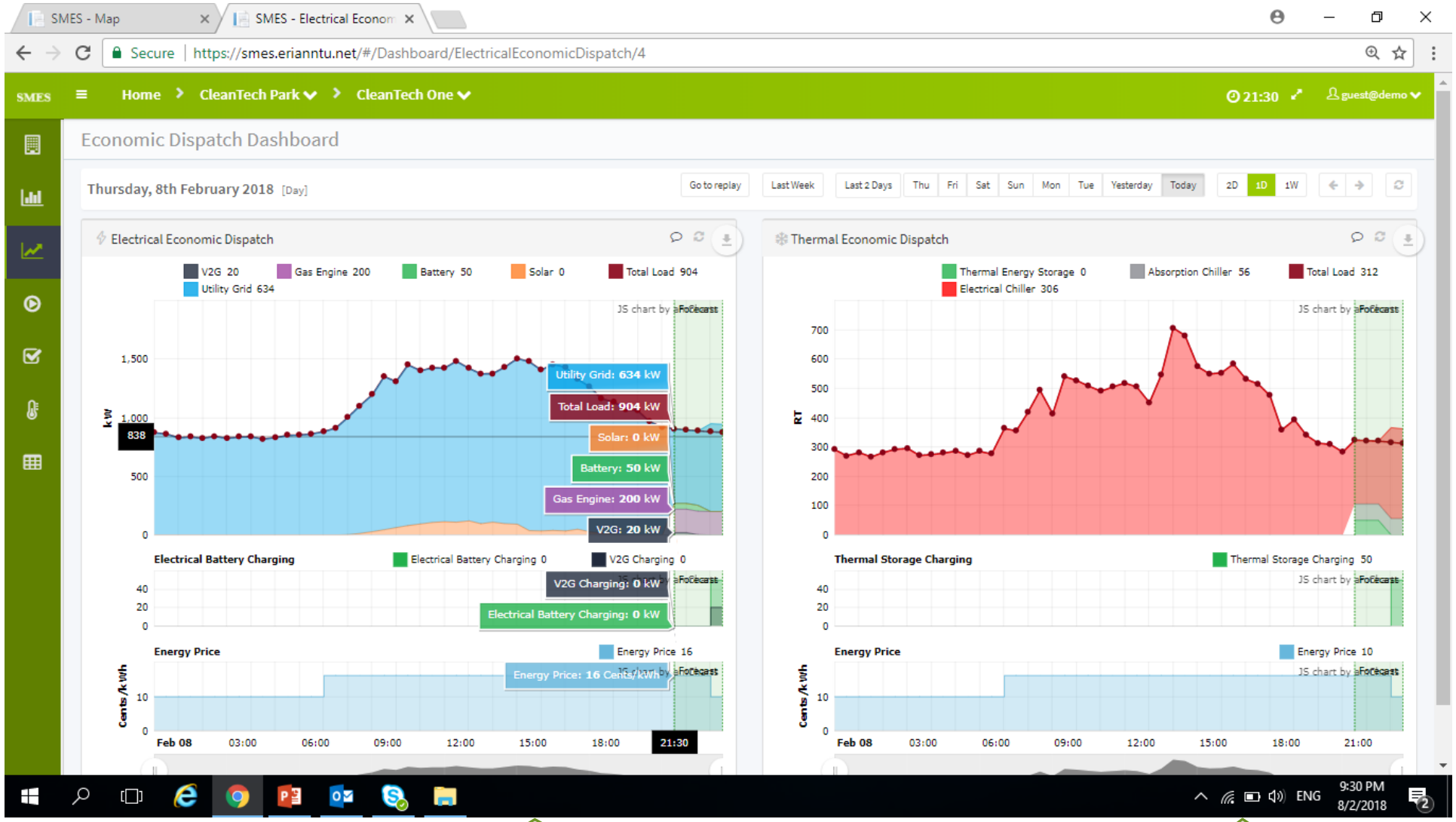
We can compare a portfolio of buildings with mixed energy contributions for benchmarking their energy performance



For each building we have a specific dashboard e.g., RTP



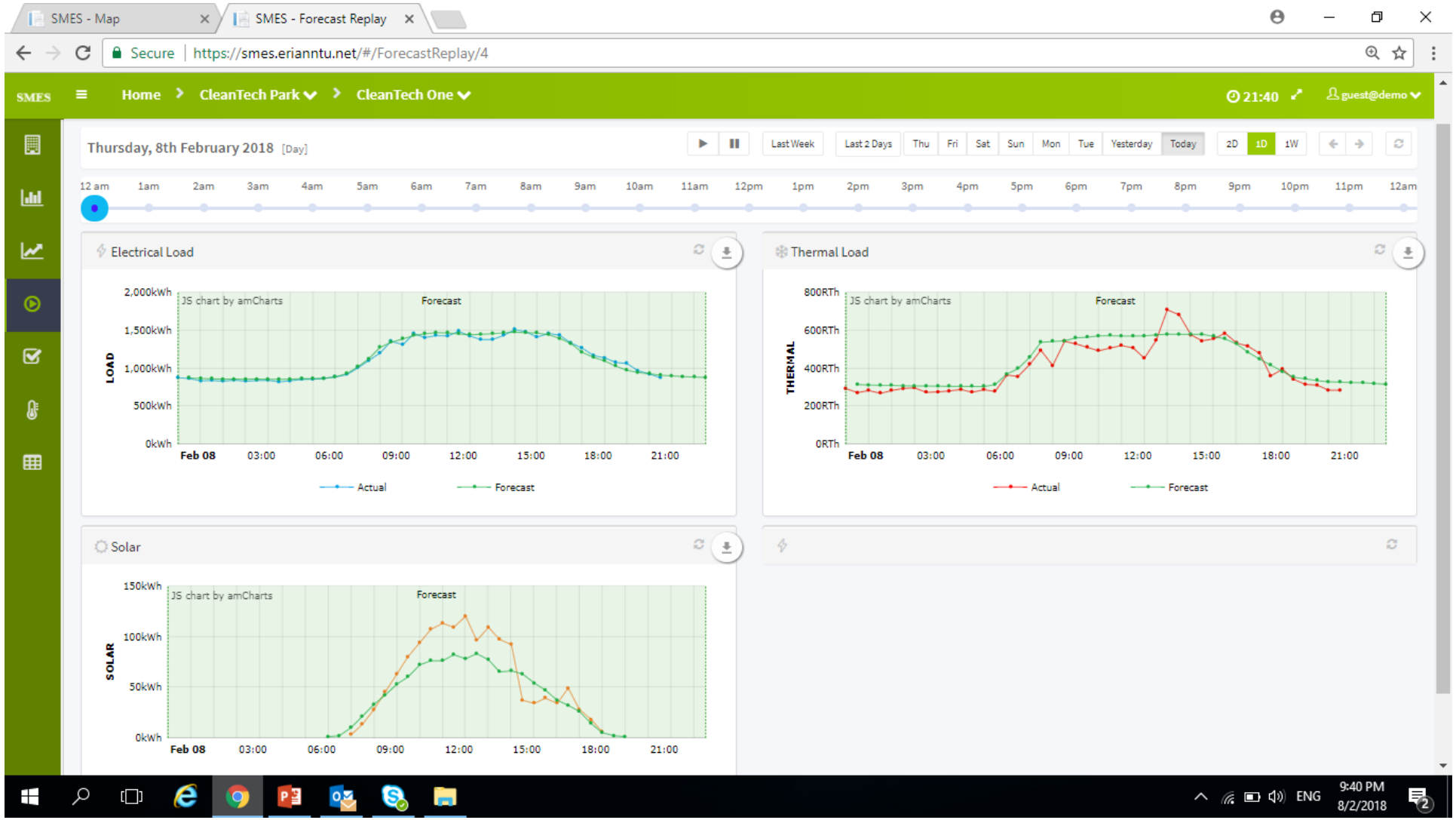
Economic dispatch for multi energy systems has been created corresponding electricity pricing contracts



Electrical economic dispatch

Thermal economic dispatch

Forecast accuracy constantly being monitored, evaluated and improved e.g., CleanTech One



Thank You