

INTELLIGENT DEMAND MANAGEMENT FOR RESILIENT POWER MARKET



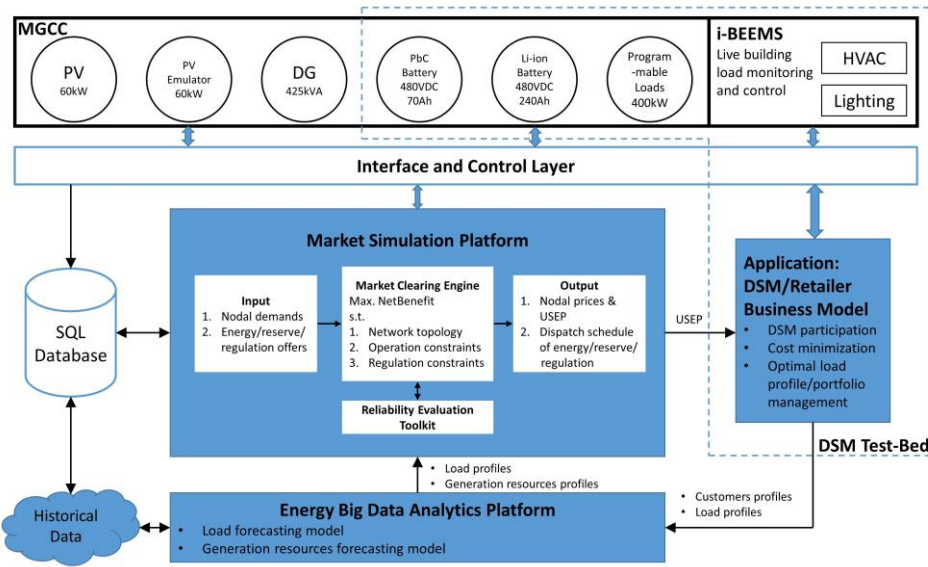
PROJECT SUMMARY

Emerging trends of demand-side management (DSM) initiatives, solar PV penetration and digitalisation amplify the complexity of the grid. This will cause fluctuations in the wholesale electricity spot prices and ancillary services prices.

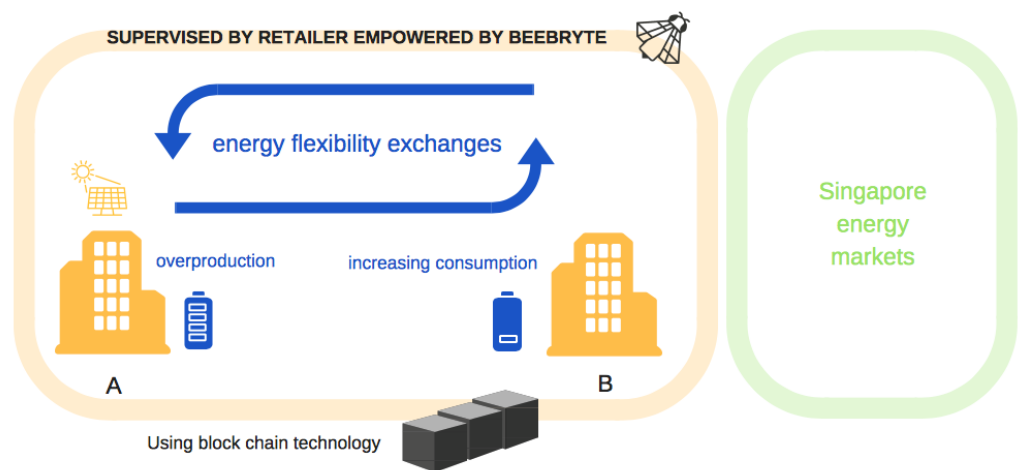
This project aims to develop a market simulation platform and a DSM test-bed to study the impacts of different DSM solutions and PV penetration on market prices and grid reliability. A DSM solution to help reduce market price spikes and provide distributed reserves for PV fluctuations will be provided and demonstrated as part of this project. This project also aims to develop and commercialize a novel digital electricity retail business model to reduce customer costs by 10-20%. The digital electricity retail model will leverage on advanced algorithms for distributed control of flexible loads and optimal energy trading, and use blockchain technology to facilitate peer-to-peer trading and payment.

OBJECTIVES:

- Market simulation platform to study new market models and policies with renewables and DSM
- DSM test-bed which provides hardware and software test-bed for DSM solution in Singapore
- Blockchain based peer-to-peer trading platform
- New retailing business model enabled by DSM and Blockchain



Electricity market simulation and DSM test-bed platform

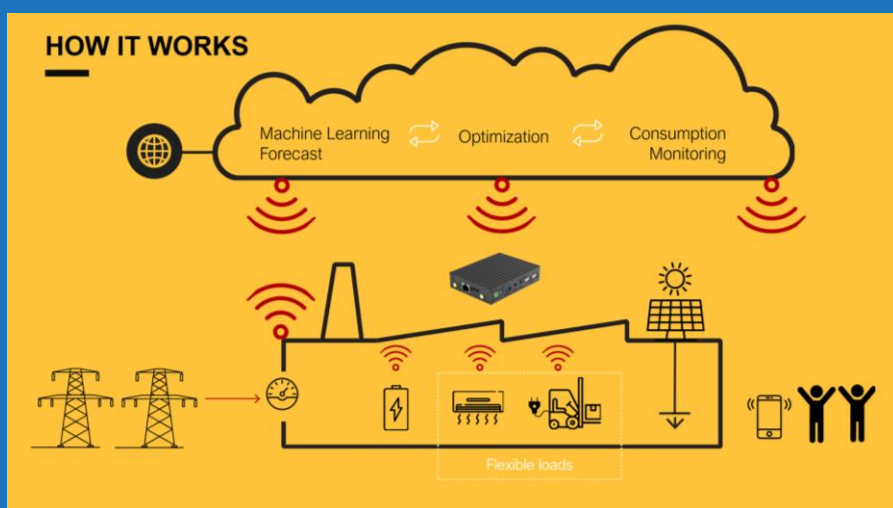


Harnessing Blockchain technology for flexibility in the energy exchange market

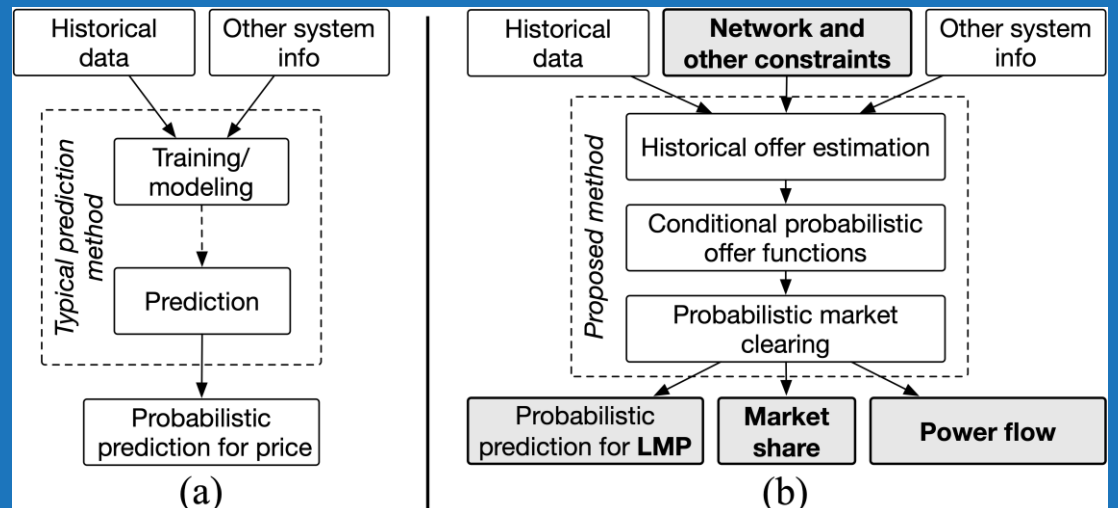
PROJECT OUTCOMES



- **Long-term and short-term demand forecast:** Models developed by exploring different time series models with extensive social, economic and weather predictors. The short-term forecast model developed achieves ~7% (Mean Average Percent Error) better accuracy than NEMS (national electricity market of Singapore) forecast.
- This is the first spatio-temporal demand forecast conducted in Singapore context and a market simulation model catering built for Singapore electricity market.
- **Market simulation platform:** Capable of providing interval prediction on the market price, market share and power flow, as opposed to traditional models' point prediction on price only.
- Capable of scenario studies for future market environment: DSM impact, demand increase, market structure changes, etc.
- **Novel digital retail market trading platform:** Reduce consumer costs by 11% - 19% using DSM, energy storage and thermal load control.
- A prototype of a crypto-secure peer-to-peer energy trading platform with peer-to-peer contracts facilitated by Proof of Authority blockchain is developed.
- **Demand-Side Management (DSM) test-bedding:** Designed, engineered and commissioned a 200 kW DSM test-bed, building on top of EPGC (Experimental Power Grid Centre, Nanyang technological University) Microgrid.
- Tested various DSM algorithms using air cooling units, energy storage in EPGC facility. The cost saving is around 4-12% in EPGC's testing setup.



Novel digital retail market trading platform: BeeBryte's technology of cloud-based DSM



Market simulation platform: Comparison of market prediction methods: (a) Typical method for market price prediction; (b) Proposed method for comprehensive market prediction.

PRINCIPAL INVESTIGATOR

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