Outline

- **Business model for shared network access**

Dr Zhipeng Zhang

- **LV load forecasting to identify the share capacity**

Dr Ran Li

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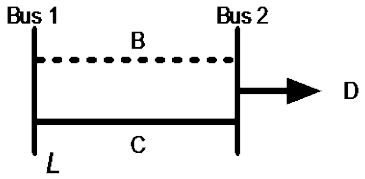
Business Modeling Aims

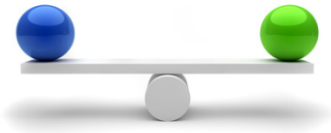
Value capture

Facilitate DER integration

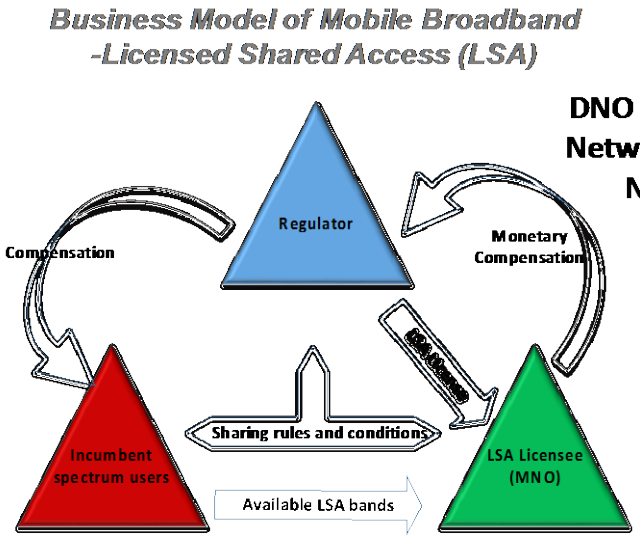
Capitalize network redundancy



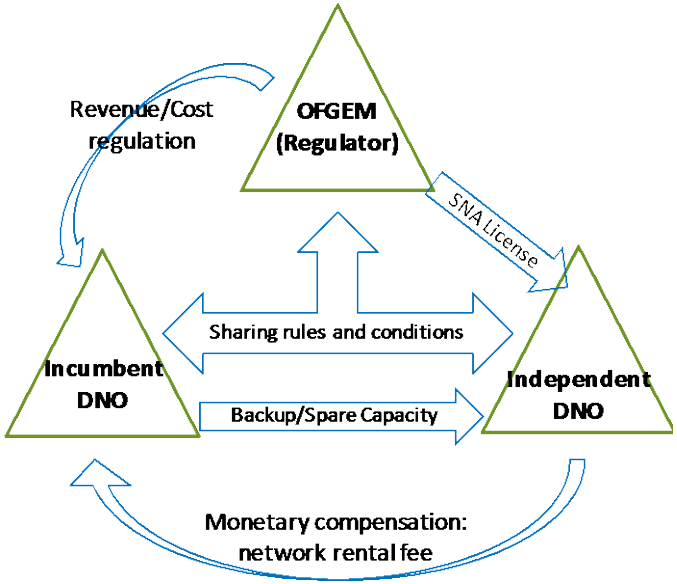
Provide level playing field: both large & small customers



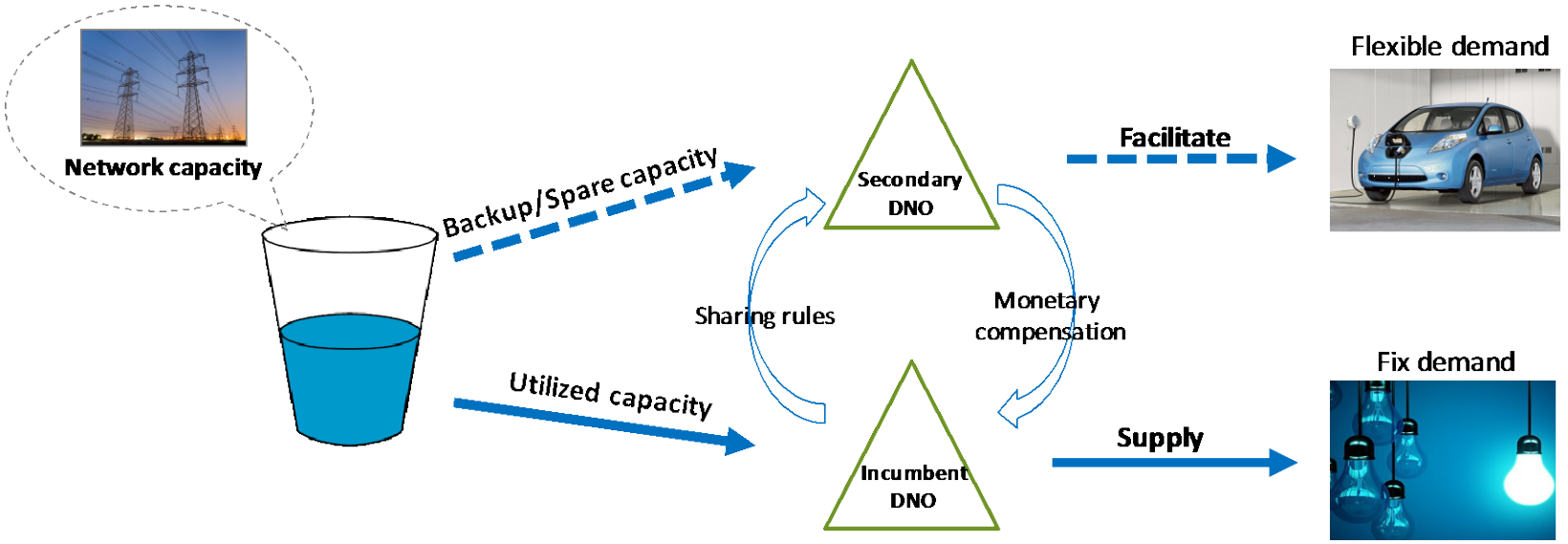
Alternative DNO Business Model



DNO business model: Multiple Network Operator with Shared Network Access (SNA)

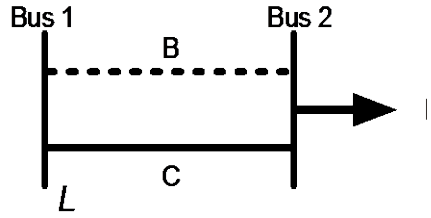


Multiple network operator with Shared Network Access

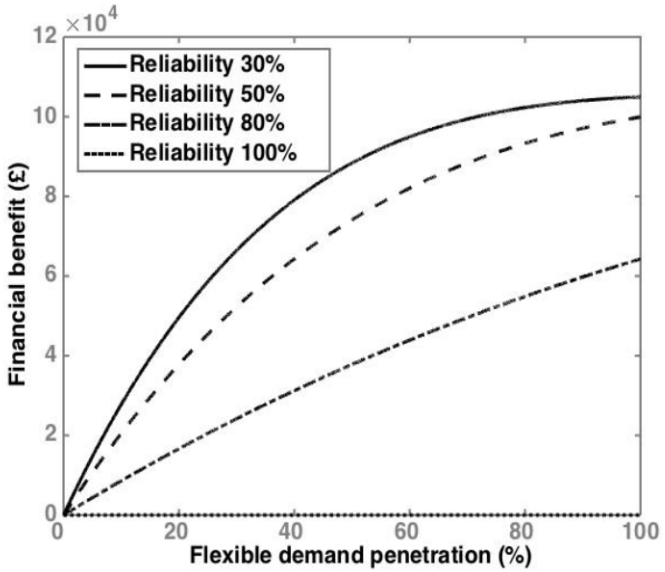


Multiple network operator with Shared Network Access (cont.)

Identify/Capture value



Capitalize network flexibility



SNA development

- **SNA concept development**

- **SNA benefit analysis**

Primary 20 MW → 1000 typical customers (2kW/house)
Secondary 20 MW → 1000 EVs (2kW/EV – low flexibility)
→ 2000 EVs (1kW/EV – medium flexibility)
→ 4000 EVs (0.5kW/EV – high flexibility)

- **SNA applications: leasing strategy, network charges …**

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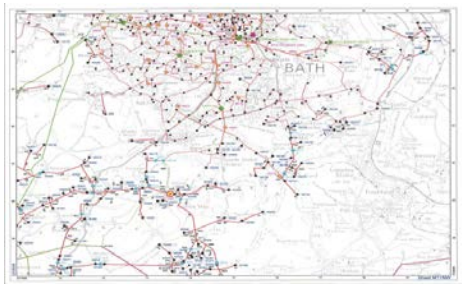
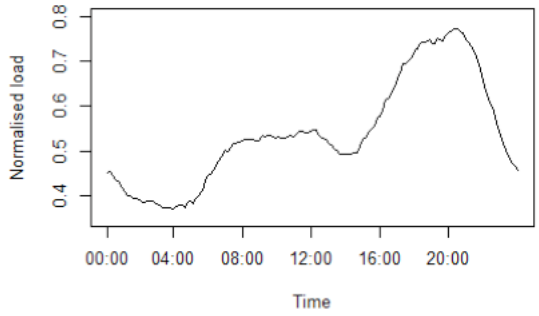
Identify the spare capacity

How to identify the spare capacity in the LV networks?

Spatial: Where is the spare capacity?



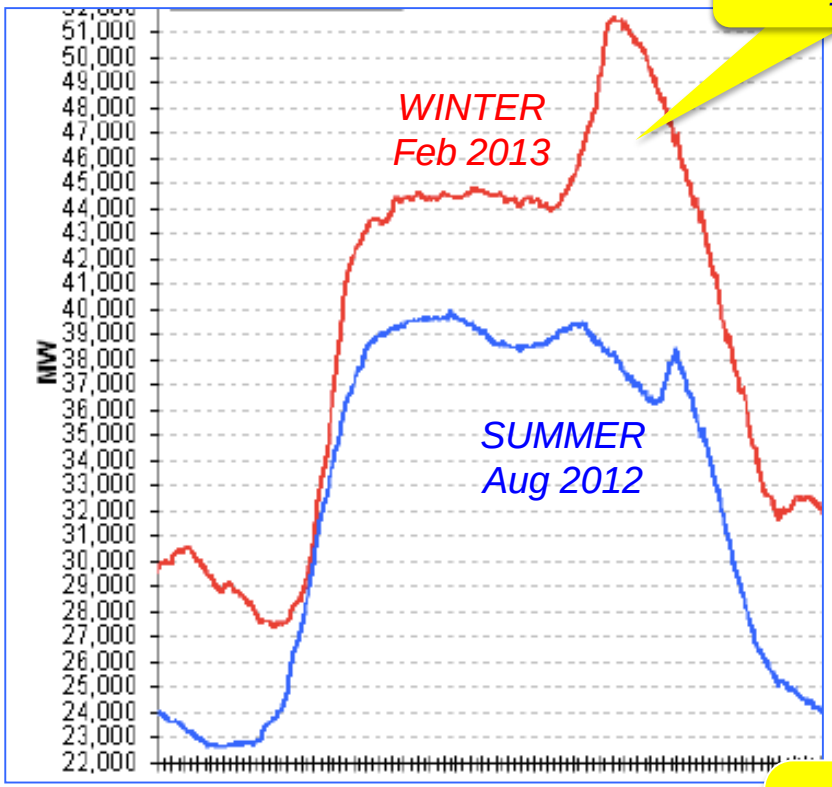
Temporal: When does it happen?



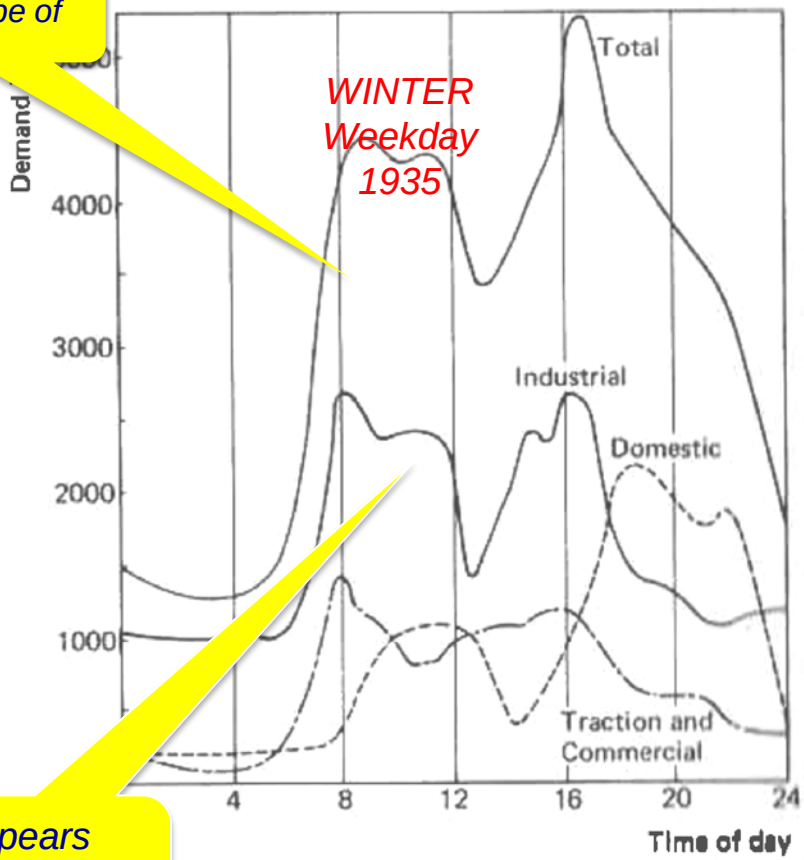
Load forecasting: predict the spatial and temporal variation of load

The aggregated GB daily load profiles are a ‘given’

For 80 years, they have underpinned investment and operation



Remarkably similar shape of Totals



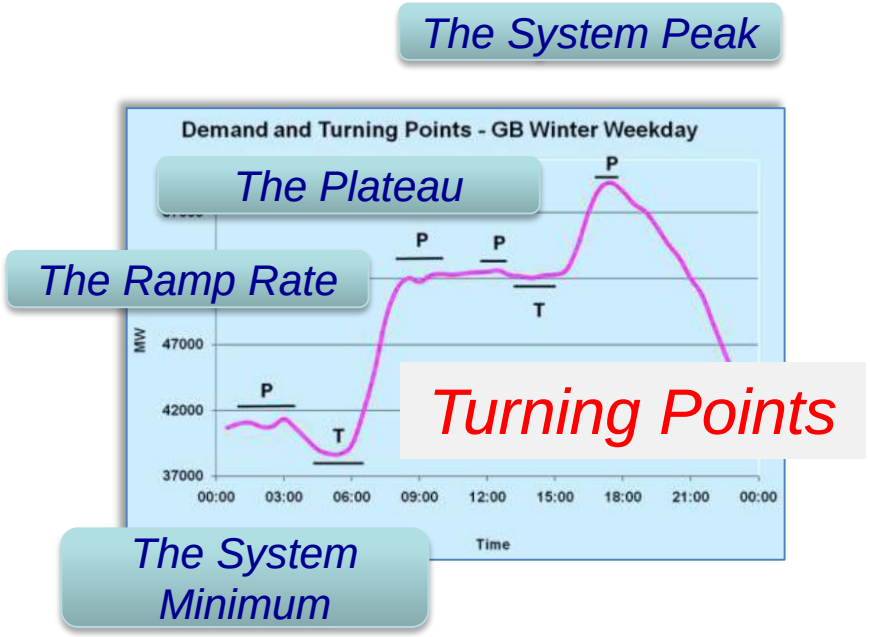
It appears Industry shut down for lunch!

The aggregated GB daily load profiles are a ‘given’

The aggregated GB load barely changes over 80 years

- Periodic features remain（Minimum, Ramp rate, Plateau, Peak…）

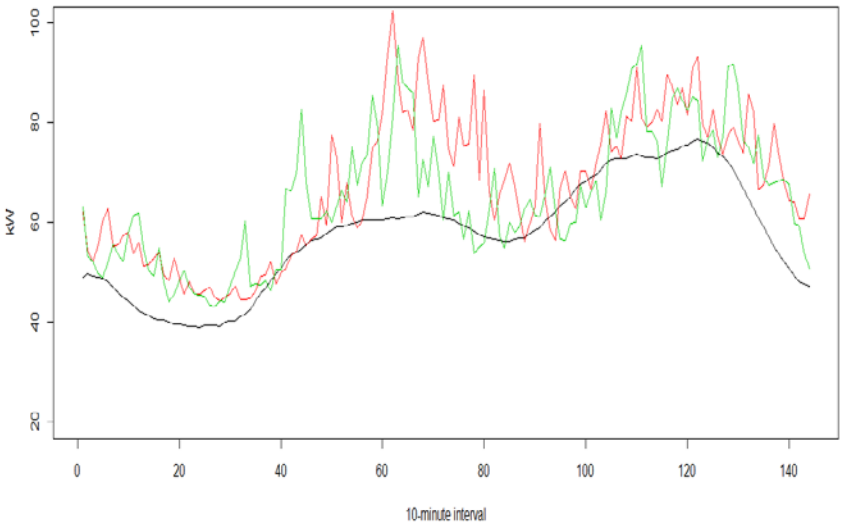
- 1G and 2G forecasting methods work fine (*Short term - MAPE 3% (for areas with peak around 10 GW)*

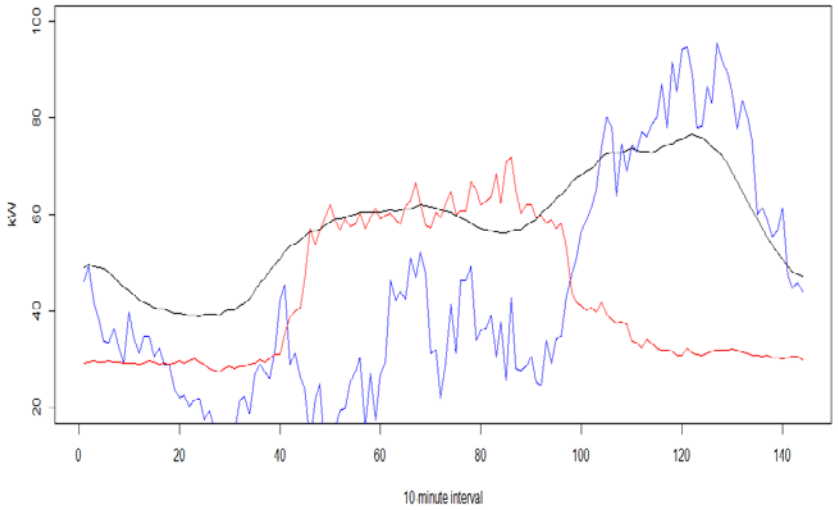


The load profiles of LV networks are a ‘myth’

The LV load can vary substantially over days

- periodicity is gone and volatility increases. 1G and 2G forecasting methods are dead (*Short term - MAPE 20% (for households)*





- Significant variation over time caused by many explanatory variables: meteorological factors (PVs), calendar (events) and demogeographic factors (tariff, EVs)

Evolution of load forecasting

1G: Rule-based system

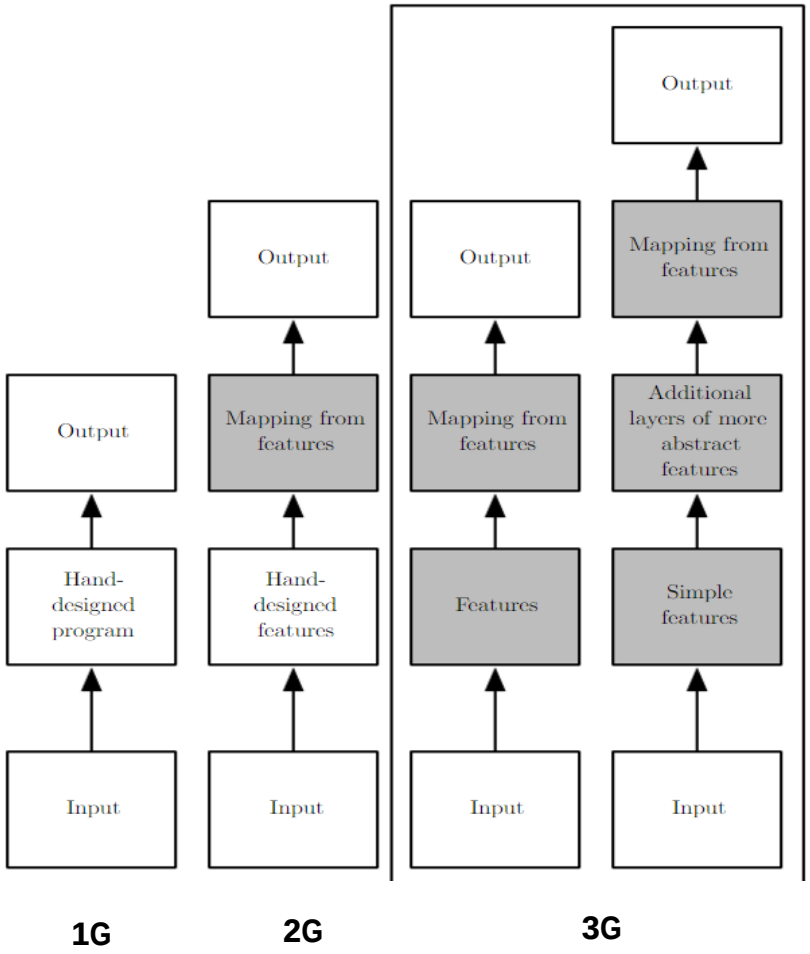
- Similar day projection from data bank

2G: System with hand-designed features

- Man-made features based on experience: features that we think will influence load

3G: System with machine-designed features (deep learning)

- Use the model to learn the features by itself



Evolution of load forecasting

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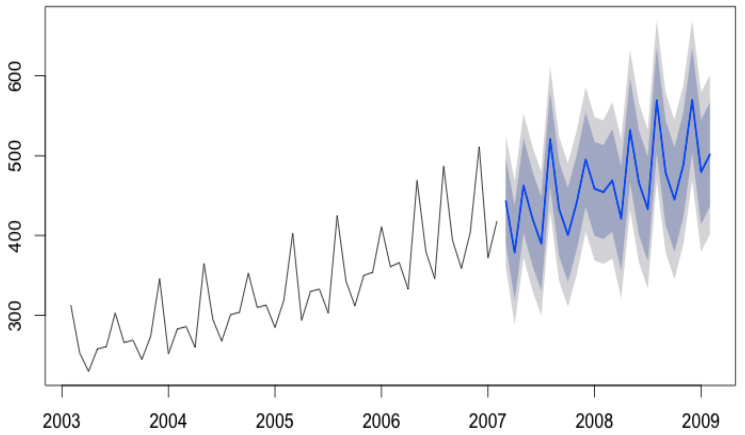
1G: Rule-based system

- Similar day projection from data bank

1G Example:
Find the overall trend and similar days to predict



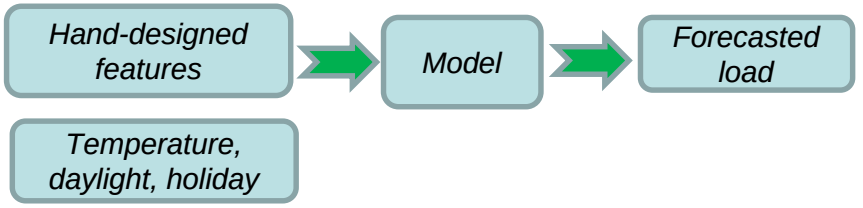
Evolution of load forecasting

2G: System with hand-designed features

- Man-made features based on experience: features that we think will influence load

2G Example:

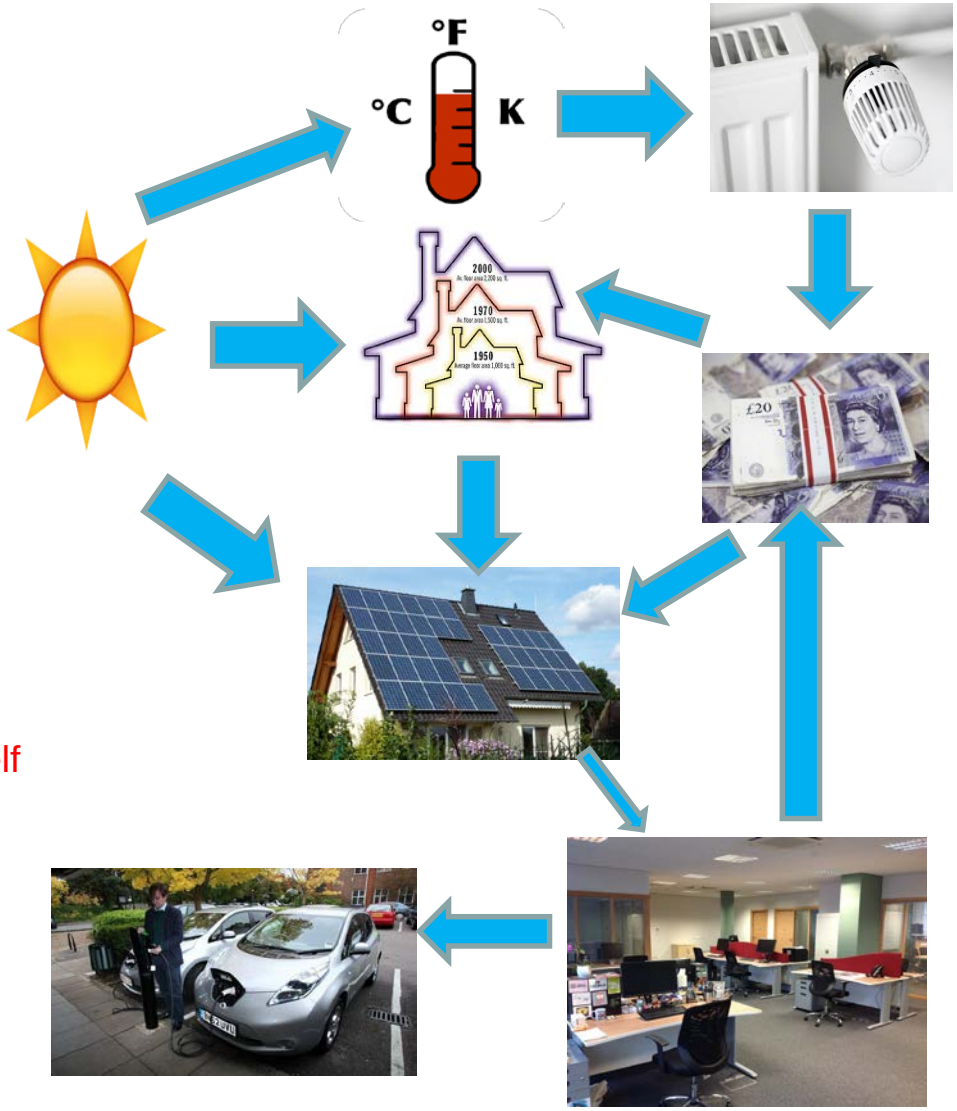
- *Use models such as SVR and neural networks to predict the load;*
- *The inputs are selected by human based on our experience;*
- *for example: temperature，calendar, temperature^2, temperature*calendar*



Evolution of load forecasting

3G Challenge:

- *massive number of variables*
- *Complex interactions between variables*
- *Impossible to hand design features based on our experience*



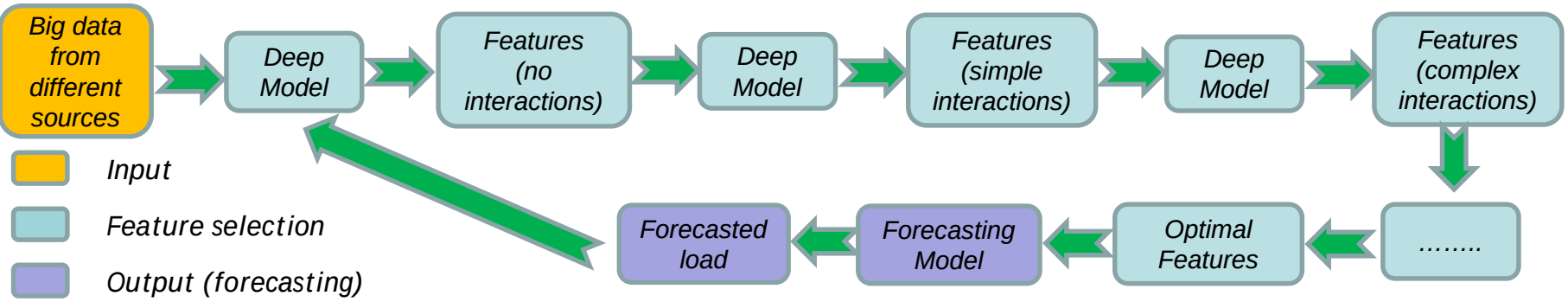
3G: System with machine-designed features (deep learning)

- Use the model to learn the features by itself

Evolution of load forecasting

3G: System with machine-designed features (deep learning)

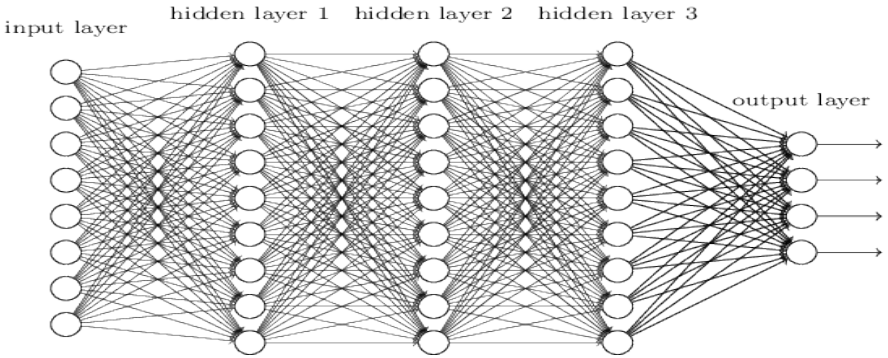
- Use the model to learn the features by itself

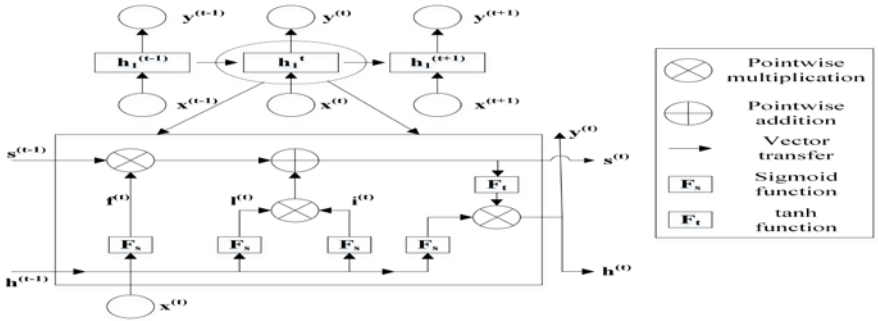


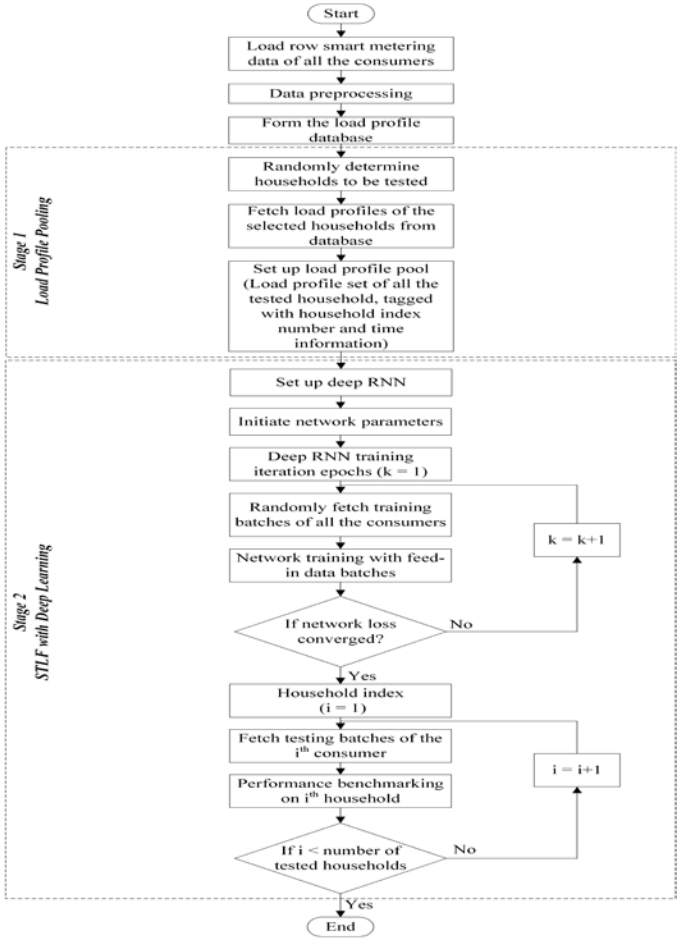
3G Example:

- *Make full use of big data collected from* ***different sources***
- *Instead of forecasting, deep learning models are used to learn the* ***features***
- *Each layer will learn the* ***interaction of features*** *from simple to complex*

Proposed deep learning forecasting model





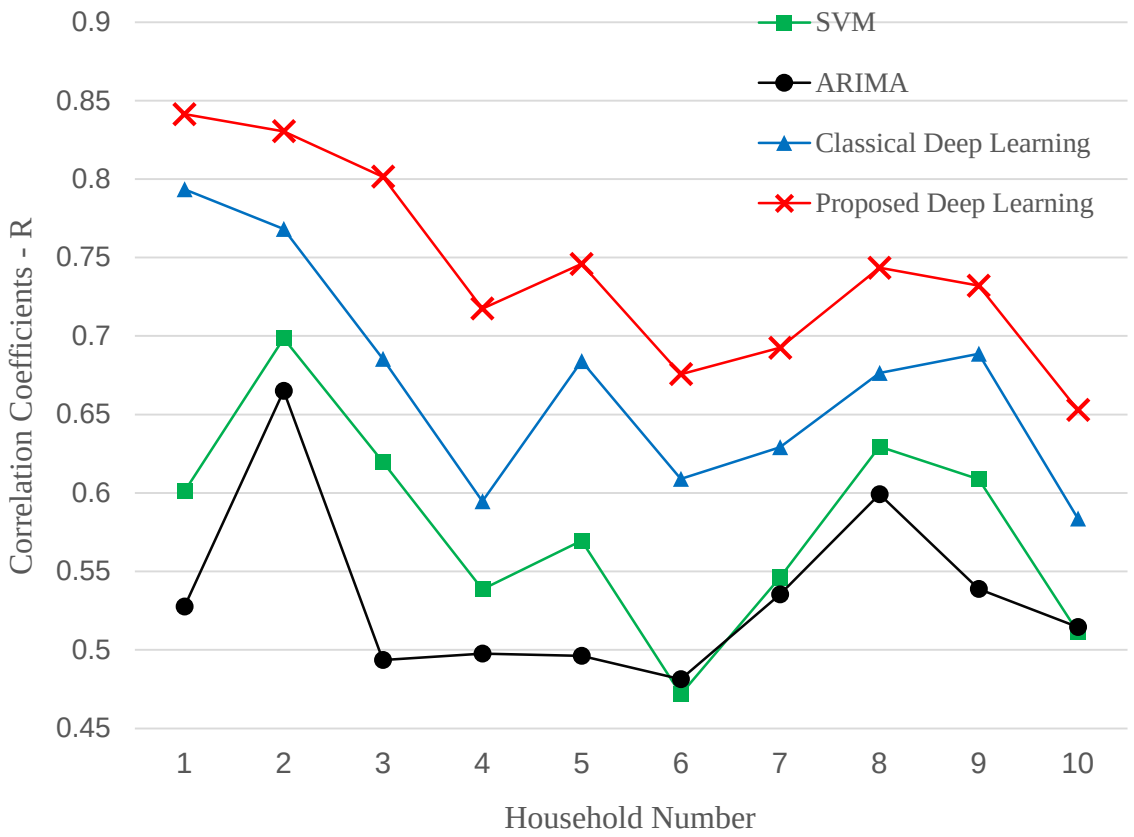


H. Shi; M. Xu; R. Li, "Deep Learning for Household Load Forecasting – A Novel Pooling Deep RNN," in *IEEE Transactions on Smart Grid* , Mar 2017, vol.PP, no.99, pp.1-1

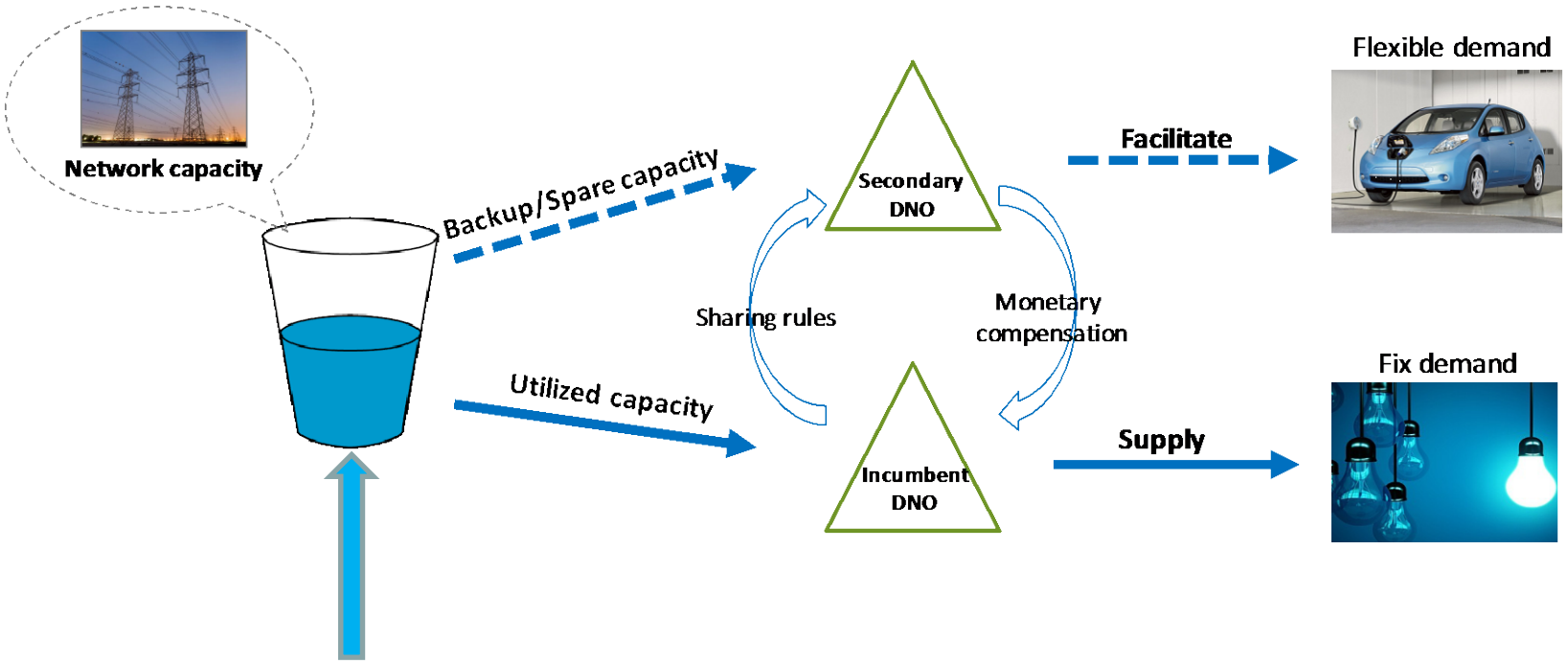
Preliminary Results

Preliminary trial: our method is tested on LV networks and compared with classic methods:

Improved 39% compared with ARIMA
Improved 28% compared with SVM



Applications



Identify the spare capacity in the LV networks:

- To better utilise the spare capacity: e.g. SNA
- To guide the connection of LCTs
- To design tailored management of flexible demand response for each network.