Safer, Stronger, Smarter Networks

Low voltage network capacity & management

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22nd October 2018

Electricity in our homes

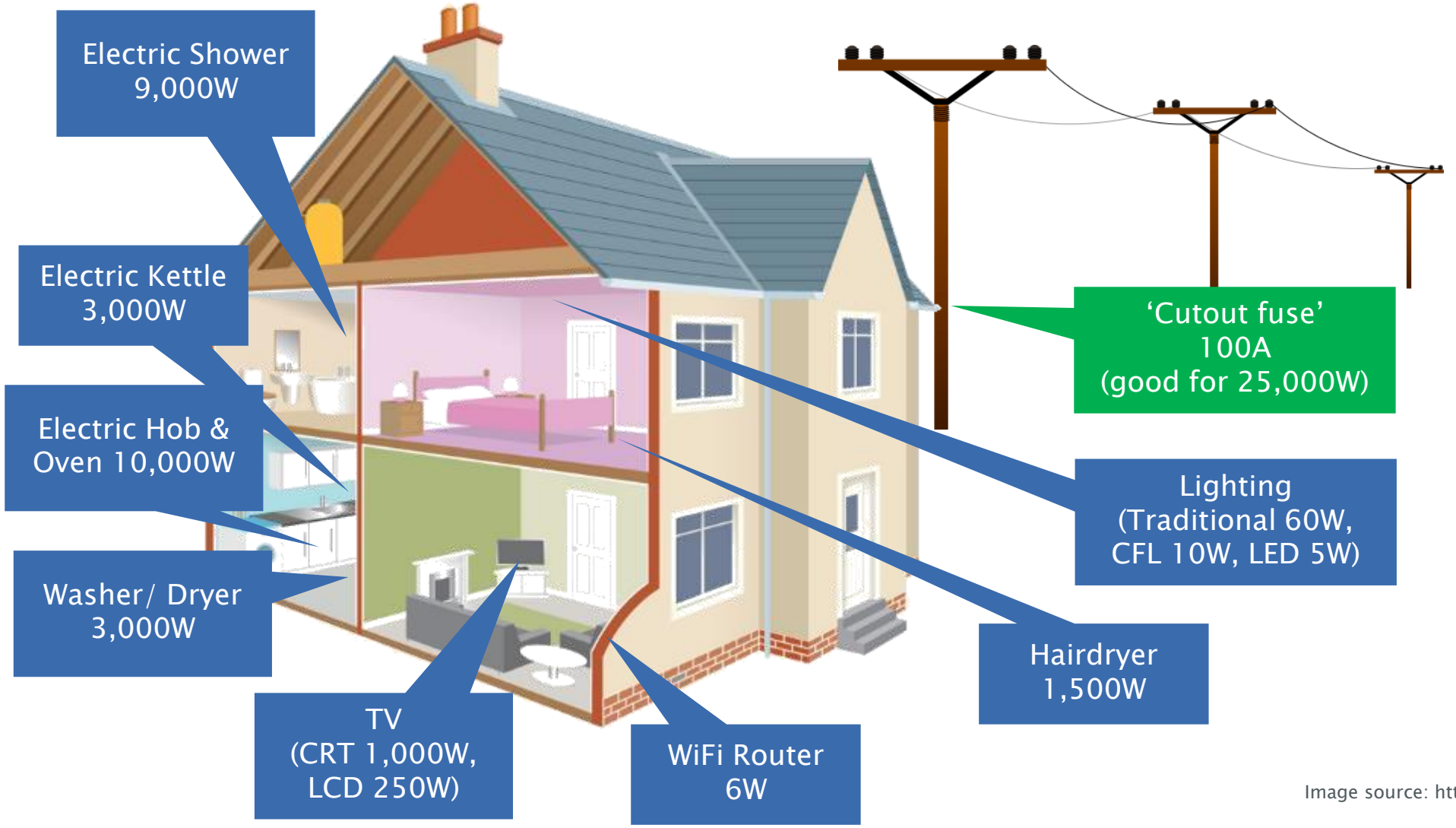
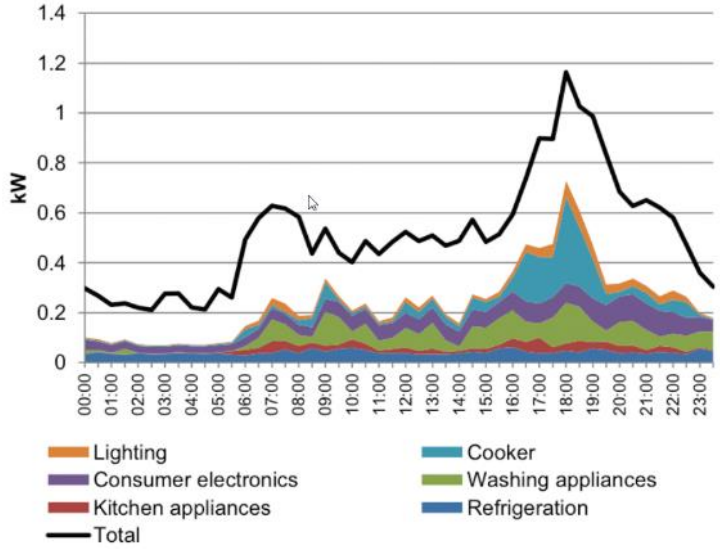


Image source: http://mckinstrie.co.uk/

Low-voltage network design

The benefits of diversity

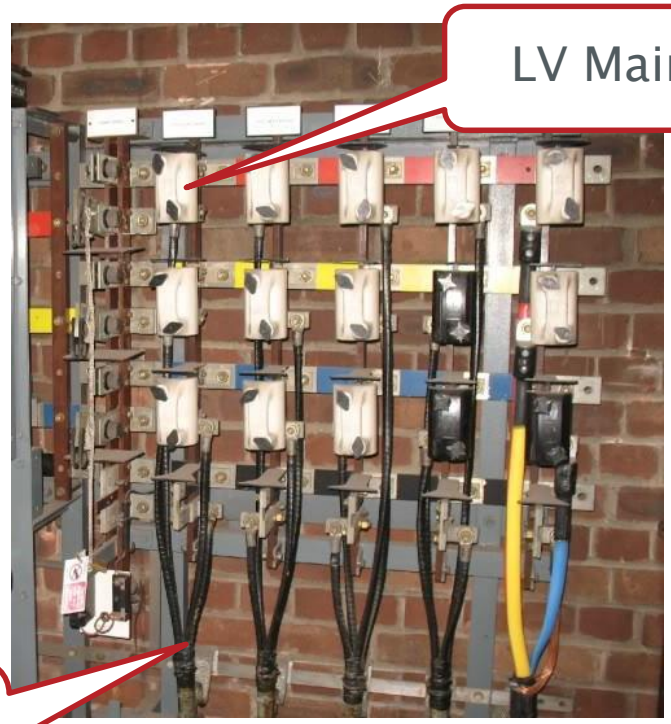
- **25kW**!
- Thankfully, we don't use all appliances at the same time…
- …nor, at the same time as our neighbours
- This is **diversity**

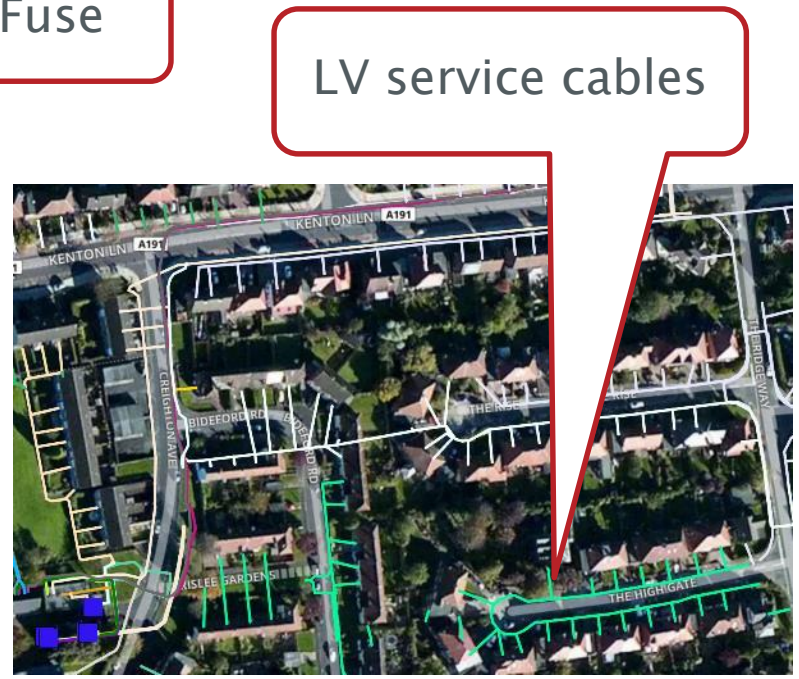


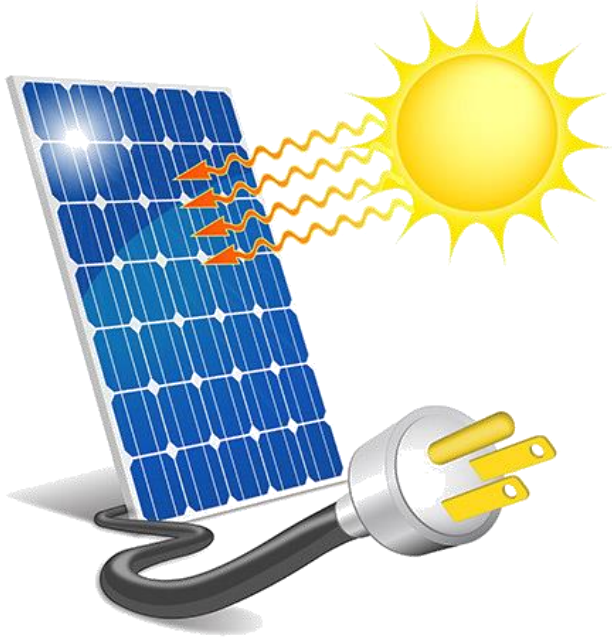
- It varies from day to day, season to season
- To a distribution network operator, a domestic customer looks like a peak demand of **around 1.2kW**

Low voltage networks

We can safely connect **300+** homes to a single **500kW** substation…







Let’s talk about energy…

Image courtesy of Npower

A kilowatt hour gives you

31 hours on a laptop

1-2 cycles in a washing machine

80 minutes using a microwave

9 uses of a kettle

27 minutes ironing

4 hours watching TV

about 12-20 minutes in full sun for PV generation...

A kilowatt hour gives you

31 hours on a laptop

1-2 cycles in a washing machine

80 minutes using a microwave

9 uses of a kettle

27 minutes ironing

4 hours watching TV

or about 4 miles of driving...

MY ELECTRIC AVENUE

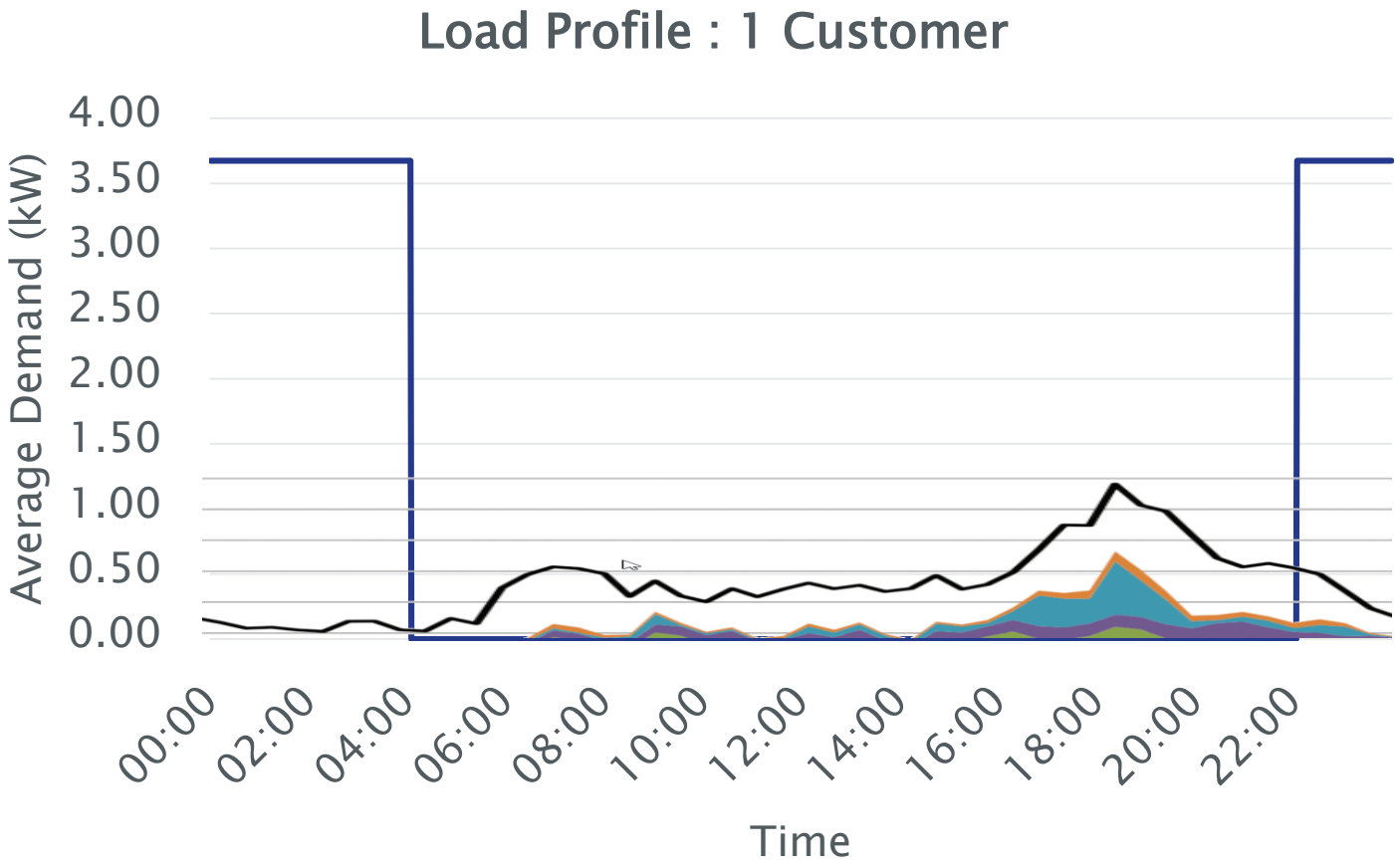
http://myelectricavenue.info

ELECTRIC NATION

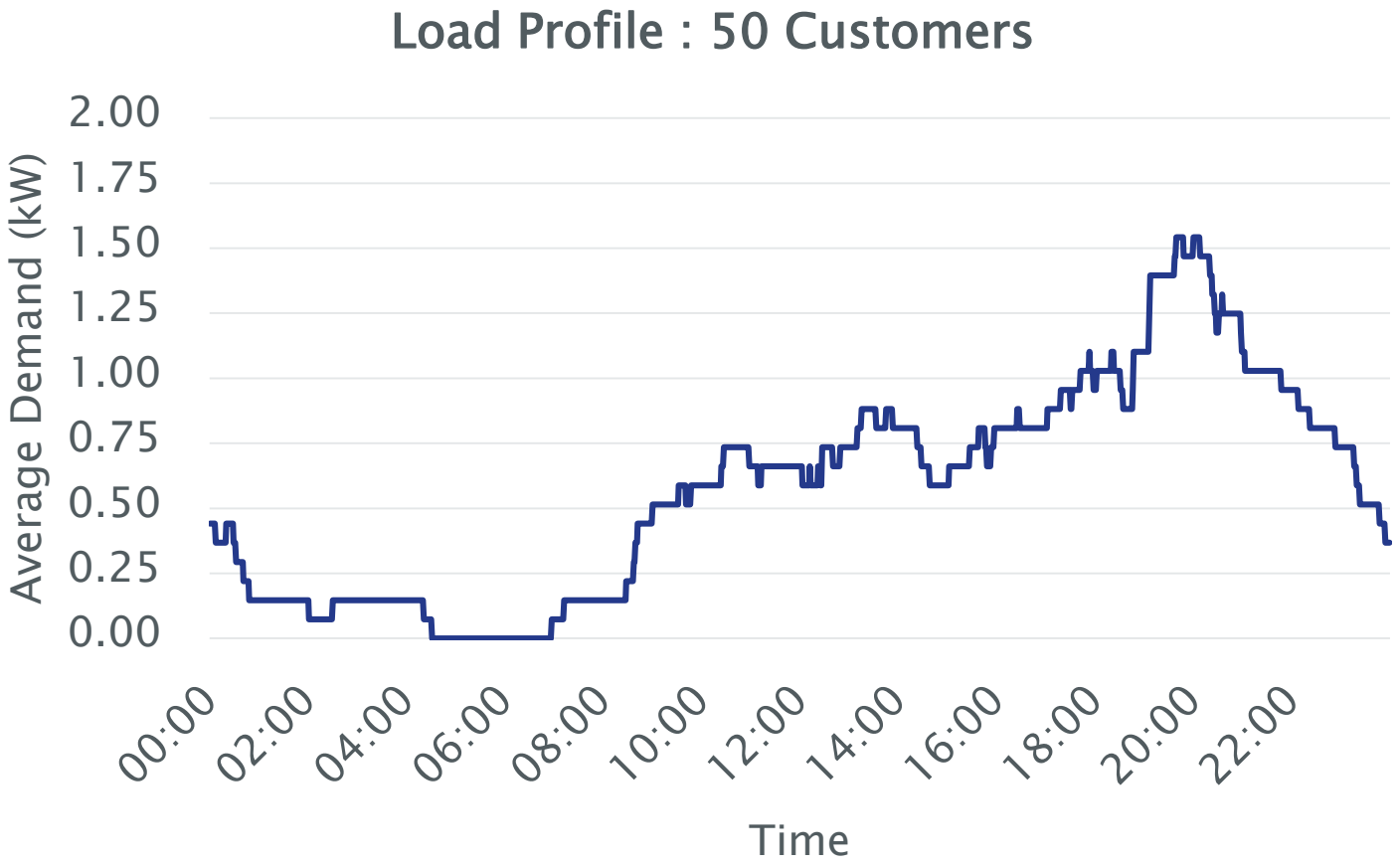
https://www.electricnation.org.uk

What does this mean for LV networks?

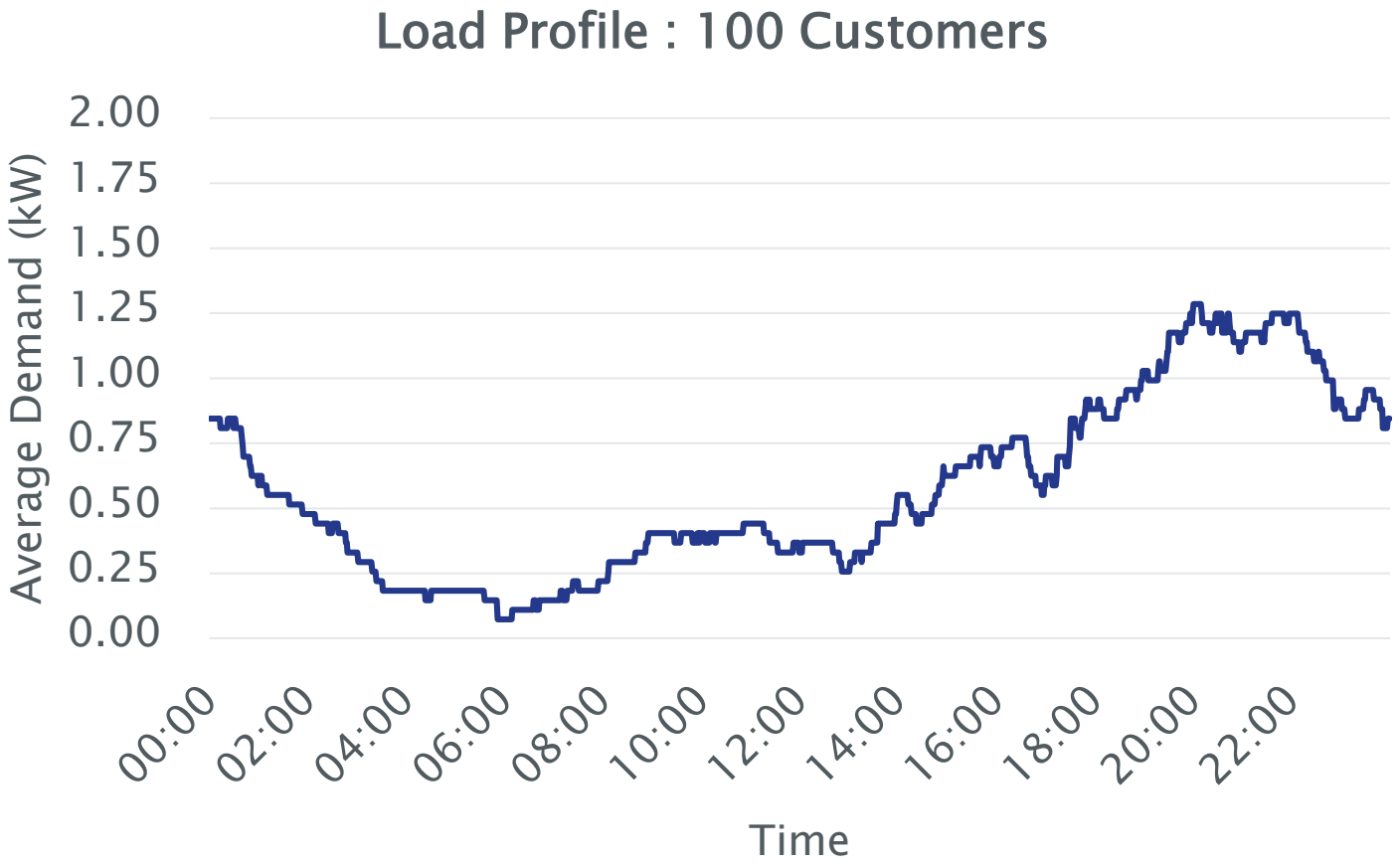
Example: charging at home



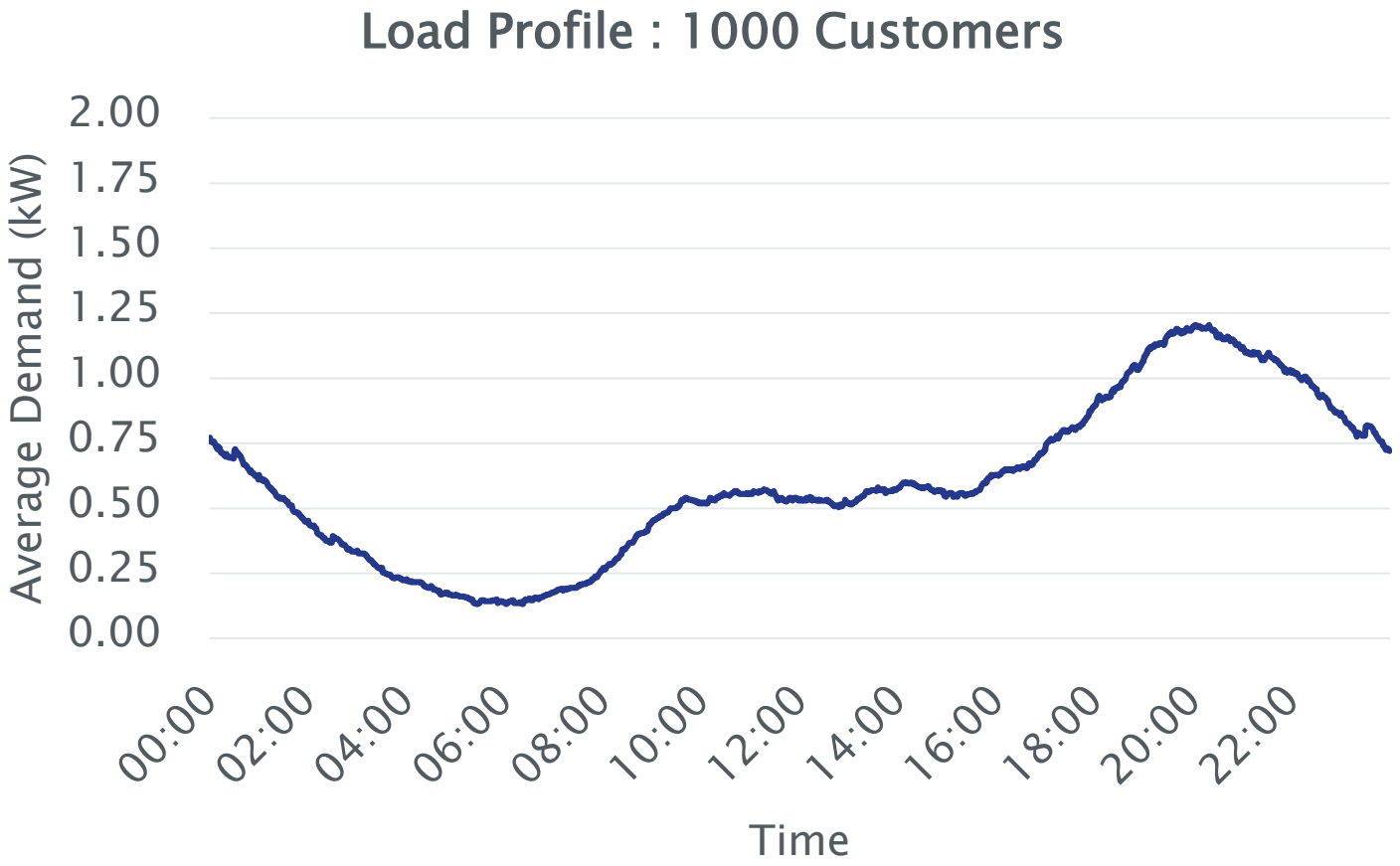
But as you get more customers…



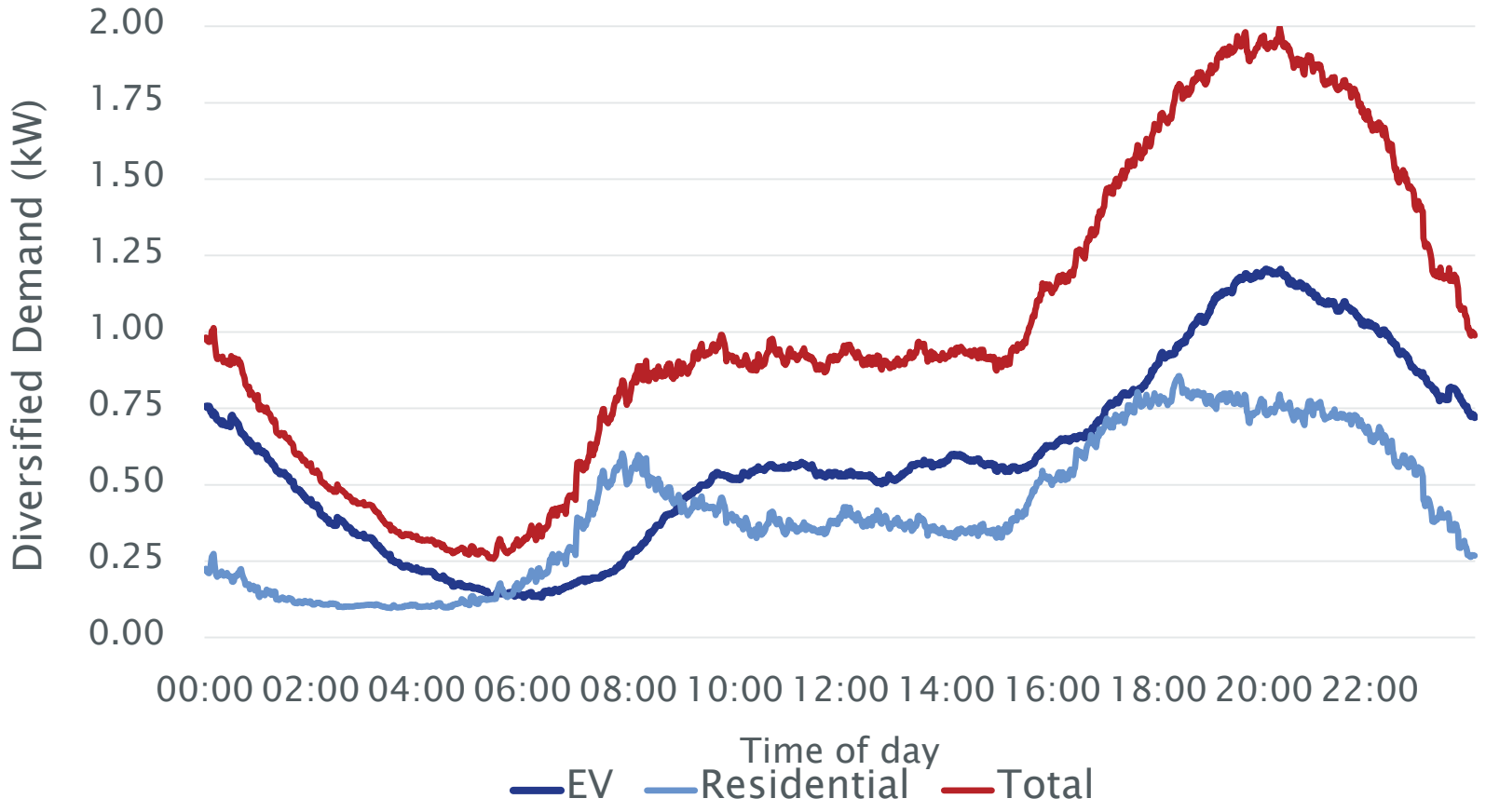
…charging peaks reduce with diversity…



…and results in a smoother profile



The result…


2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Diversified Demand (kW)
00:00 02:00 04:00 06:00 08:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00
Time of day
EV
Residential
Total

The impact of home charging

- This means we can safely connect 300+ **150** homes to a single 500kW substation

Is this manageable?

- Yes!
- EVs **do** represent potentially massive shift in load patterns for LV networks
- Average daily commute is around 35 miles[1]
  - That's only ~8kWh
  - Most cars are stationary for most of the day (at home, at work, at the shops)
- There is plenty of diversity
  - Not everyone needs to charge at exactly the same place at the same time

[1] Source: Randstad

One solution
(there are many…)

Encourage charging whenever the car is stationary (so-called ‘grazing’)

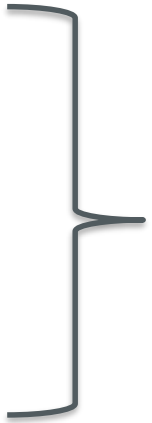
Install charging infrastructure **everywhere**

“Smart charging” can take care of the local constraints

Leaving plenty of network capacity for those who *need* to charge…

Open questions…

- Where *exactly* are the constraints?
  - Need for “heat maps” showing LV network headroom
- How long have we got?
  - Need accurate forecasts of EV numbers
  - Modelling to estimate when network capacity will be exhausted
- Technical solutions
  - Reinforcement
  - Restricted charging
  - Smart charging
  - V2G
  - …?



Acceptability, effectiveness, cost benefit analysis…

Thank you

For further information

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