Clean Heat Accelerator

Flexibility and Timeshifting

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What is flexibility?

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Ability to adjust the way we use energy

in response to signals from the system / market,

e.g. to shift demand up or down to meet available generation and network capacity,

e.g. to shift demand to times when energy is cheaper or networks are less overloaded

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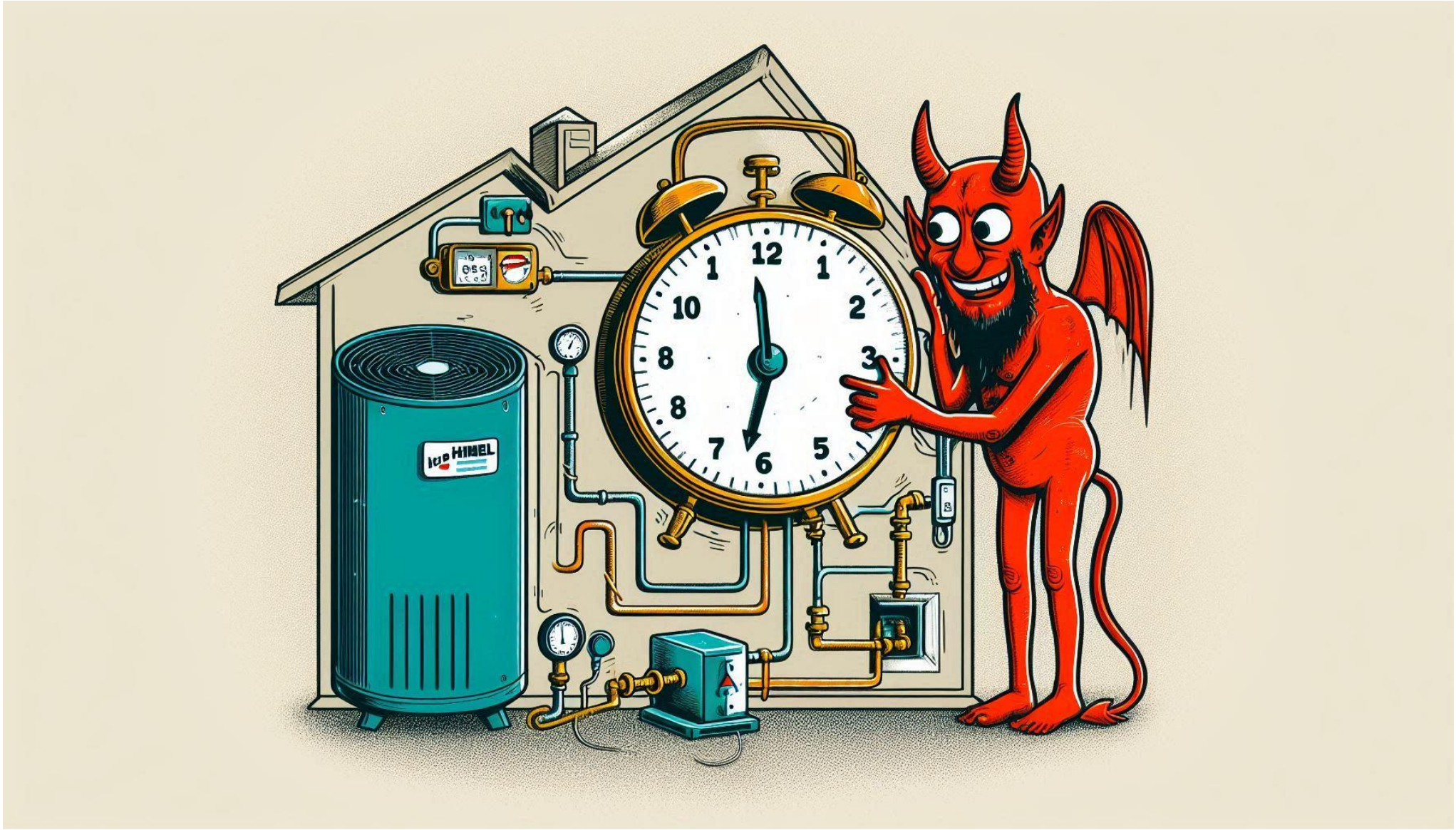
The energy system has always had flexibility

But solar and wind won’t shift to meet our needs

So we need to generate flexibility separately to power



What is flexibility used for?

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- **National Balancing**: Matching the overall amount of generation to the amount of demand. Traditionally, generation was flexed to match changes in demand. Increasingly, flexible demand will be adjusted to fit with available generation, or the growing volume of energy storage systems (ESS) will be used to maintain the balance. This must take place at timescales ranging from years (planning & building systems) to sub-second (maintaining realtime balance of supply & demand).
- **System Operability**: The Energy System Operator (ESO) manages system stability & reliability through ancillary services for:
  - **Response**: Maintaining the system within statutory frequency limits of 50 +/- 0.5 Hz. This requires fast acting (sub-second), short duration (minutes) services that can respond to frequency changes due to fluctuations in supply or demand, plant outages, etc.
  - **Reserve**: Providing energy reserves to cover gaps between supply and demand, e.g. for the period it takes for plant to start up following an outage. These services tend to be slower acting (minutes) and longer duration (hours) than the above response services.
  - **Reactive Power**: Managing voltage on transmission & distribution lines. This is done by injecting or absorbing reactive power, and needs to be managed at regional rather than national scale. It is a growing issue as growth of distributed generation changes patterns of energy flow on the network.
  - **Restoration**: Restoring power after a complete system outage. This requires coordination of assets as they restart, and will grow more complex as the number and distribution of assets grows.
- **Network Constraints**: ESO and DSOs manage power flows to stay within capacity constraints of network lines, substations, etc. This is a particular issue across boundaries such as that between Scotland & England. Managing it typically requires generation to be curtailed on one side of the boundary and increased on the other (or equivalent adjustments in demand).
- **Other (often less explicit) Value Streams**: Flexibility can also provide optionality to help manage timing of investment and scheduling of work programmes. Although valuable, such optionality can be difficult to quantify and monetise. Similarly, flexibility could be used to manage issues such as losses on transmission and distribution networks.

Adding Flexibility helps address wider societal issues

Affordability	• Shift demand to times when energy is cheap / export when expensive • Earn additional revenues by providing services to ESO & DSO • Hedge against risks in wholesale markets
Security of Supply	• Reduce demand / increase generation when energy is scarce • Store energy (batteries, thermal inertia, etc) for times of scarcity • Earning revenue from ESO or DSO enables investment in generation
Decarbonisation	• Shift demand to times of clean energy / efficient generation • Improve returns from low carbon generation • Improve value of low carbon technologies such as EVs, heat pumps
Pace of Investment	• Reduce peak demand / flow, reducing need for generation & network • Increase utilisation of generation & network, improving economics • Defer investment until greater certainty, avoiding risk of stranding
Consumer / Customer / Citizen Trust & Value	• Enable products based on broader value (convenience, locality, community ownership, …) • Enable people and community to participate more actively

Who buys it?

Can recognise four broad groups who might want to buy flexibility:

1) **ESO** – operates reasonably well developed (although still rapidly evolving) markets for ancillary services, Balancing Mechanism, capacity market

2) **DSOs** – operate emerging markets for the flex products defined by the Energy Networks Association (ENA) in their Open Networks project

3) **Suppliers & Traders** – can use flexibility to manage / hedge their position on wholesale & imbalance markets

4) **Customers** – consumers and generators can use flexibility to optimise the price they pay / receive for energy

How much do they spend on it?

1) **ESO**

- £3-4bn p.a. and growing currently
- Network build may reduce constraint payments
- Balancing Mechanism is about half of this
- Rest is spread across many smaller (hence less liquid and prone to saturation) and often more technical markets
- DFS is emerging as an accessible market, but will it sustain attractive pricing?

2) **DSOs**

- Lots of noise, but maybe £100-200m p.a. currently
- Useful top-up if in right location
- Easy to access
- Typically time-limited: defers reinforcement, doesn't avoid it
- Slow to address concerns like stackability
- Slow to address new services like demand turn-up to accelerate connections

3) **Suppliers & Traders**

4) **Consumers & Generators**

- Scope to reduce costs / enhance revenue by 10-20%
- Market is £20-40bn p.a., so this translates to £2-8bn p.a.
- Large market so less prone to saturation
- Value of accelerated connections is additional, but hard to quantify
- NB savings need to be shared with the end customer, and will be spread across these different groups: who captures what?
- And tend to need to work with licensed party to access it
- And subject to market volatility, geopolitical risk, build out of generation, etc: hard to predict pricing over lifetime of a typical asset

What sort of business models does this create?

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1) Sell flexibility to system operators
2) Sell flexibility to suppliers
3) Trade direct on energy markets
4) Help consumers manage their energy costs
5) Help generators maximise their returns
6) Use flexibility to enhance equipment sales
7) Use flexibility to enhance customer loyalty / gamification
8) Use flexibility as a gateway to other adjacencies (e.g. to fund installation of home security or other kit)

What sort of business models does this create?

1) Sell flexibility to system operators
    - Direct sales – site sells to SO, with advice from specialist (consultancy)
    - Aggregator – integrates multiple sites to create a ”VPP” to sell to SO
        - Typically takes a percentage of the revenue
        - May also charge upfront integration and ongoing service fees.
          (This is largely about balancing risk & reward between parties.)
    - Part of supply contract – supplier acts as aggregator, giving the customer reduced energy costs
        - Benefits may be returned as a rebate, or an upfront discount to the tariff. Again, this is about risk allocation.
        - In extremis, this grades into Energy-as-a-Service models, where the supplier provides energy for a fixed monthly cost. Supplier now assumes risks regarding energy efficiency, weather, etc. May be mitigated by fair use policies and suchlike. Supplier will want a lot more control of equipment to manage this risk.
        - Most suppliers probably need a platform partner to execute this type of model.

    - NB SOs buy flex through auctions, so this market is always going to be price sensitive, and it will tend to have relatively low margins as more flex service providers enter the market.

What sort of business models does this create?

2) Sell flexibility to suppliers
   - E.g. as an extension to aggregator model, targeting an additional customer segment
   - Helps them manage their position/risk in wholesale and imbalance markets
   - Target model for some aggregators
   - Tolling agreements

   - NB Suppliers are in a regulatory privileged position. They have good access to customers, but also a lot of negotiating leverage when dealing with service providers.

What sort of business models does this create?

3) Trade direct on energy markets
   - Extends SO models from markets like BM to wholesale market.
   - Requires suitable licenses, etc.
   - This is the realm of optimisers and grid-scale battery managers, but is opening to aggregators (P415)

   - NB these markets tend to be dominated (& even saturated) by large assets which have economies of scale. Smaller assets tend to have low asset costs (as the assets are there for other reasons) but high recruitment costs.

What sort of business models does this create?

4) Help consumers manage their energy costs

- Exploit Time-of-Use tariffs
- Energy management, for monthly fee or share of savings
- Energy-as-a-Service. Again, this entails assuming risk; the provider will want control over kit to mitigate it.
- Aggregate customers to help them negotiate with suppliers. Provide ability to shape their consumption to aid negotiations. Extends models like Solar Together. (Interesting, but no examples I know of.)
- Flex for microgrids, via dedicated battery or VPP or tolling agreement.
- Flex to accelerate connection times and reduce network charges.

- NB getting access to individual customers is hard, but once you have it it's very valuable – you can sell a lot of adjacent products and services.
- The key barrier is trust – flex is a complex concept for most consumers (domestic & commercial) to understand, and the revenues are more uncertain than most will be comfortable with.

What sort of business models does this create?

5) Help generators maximise their revenues

- Timeshift generation to peak times on wholesale markets
- Optimise use of constrained network capacity
- Convert non-firm to firm power, and so write better PPAs
- Co-located storage
- Tolling agreements

- Not really a market that flex providers have gone after, apart from co-located storage.

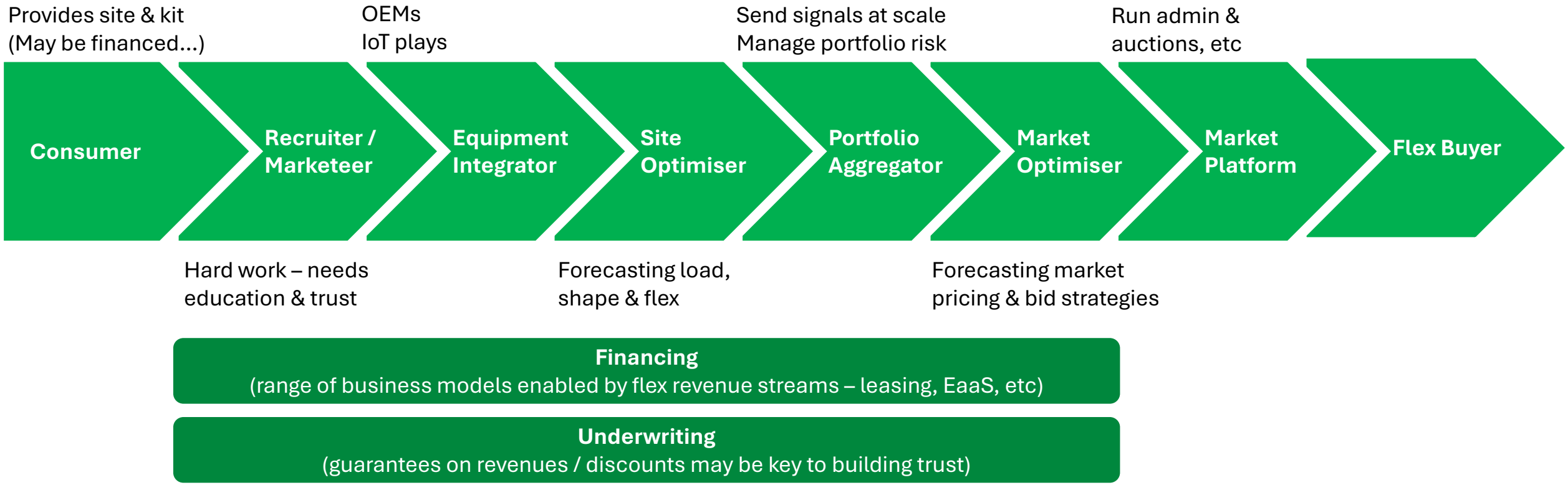
What sort of business models does this create?

6) Use flexibility to enhance equipment sales
   - Make kit more attractive because it can earn a revenue stream
   - Help OEMs capture downstream revenue, so they can discount kit
   - Help OEMs capture downstream revenue, which they use to discount service contracts. Potentially very attractive to channel.
   - Use data gathered as part of the process to trigger preventive maintenance
   - Use flex to manage equipment life
   - Use flex and data to assure quality of kit for second hand market

7) Use flexibility to enhance customer loyalty / gamification

8) Use flex as gateway to other adjacencies
   (e.g. to fund installation of home security or other kit)

What sort of value chain is emerging?



What are the risks?

- Customer understanding (and mis-selling)
- Backlash against energy transition (flex is a counter to this, if it gives consumers a stake)
- Rapid shifts during time of transition
- Geopolitical events drive energy costs, and hence volatility and returns
- Market saturation (e.g. 20 million EVs = a lot of flex. How does this balance growing volatility of generation?_
- System is very conservative and slow to change
    - Network build out
    - CCUS
    - Grid-scale batteries (not LV!)

What might this mean for you?

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Thank You

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