



Hirst Solutions Limited

Innovation Technology Sustainability

Consumer Freedoms, Intelligent Demand Response, and the Disaster of Retail Electricity Competition

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Markets Pricing & Smart Grids

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Agenda

- Market Balancing with Fridges
- Demand Response by Intelligent Pricing
- Freedoms and the Smart Grid
- Retail Electricity Competition does not help

The Central Importance of System Frequency

- Electricity is in Dynamic Balance
 - No inherent Storage
 - Demand must influence supply in Real Time
 - Across the whole system
- Frequency (50Hz or 60Hz) reflects the imbalance
 - Cheap to read anywhere and everywhere
- Used today to influence generator behaviour

System frequency (Hz)

Stavanger, 10/6/4

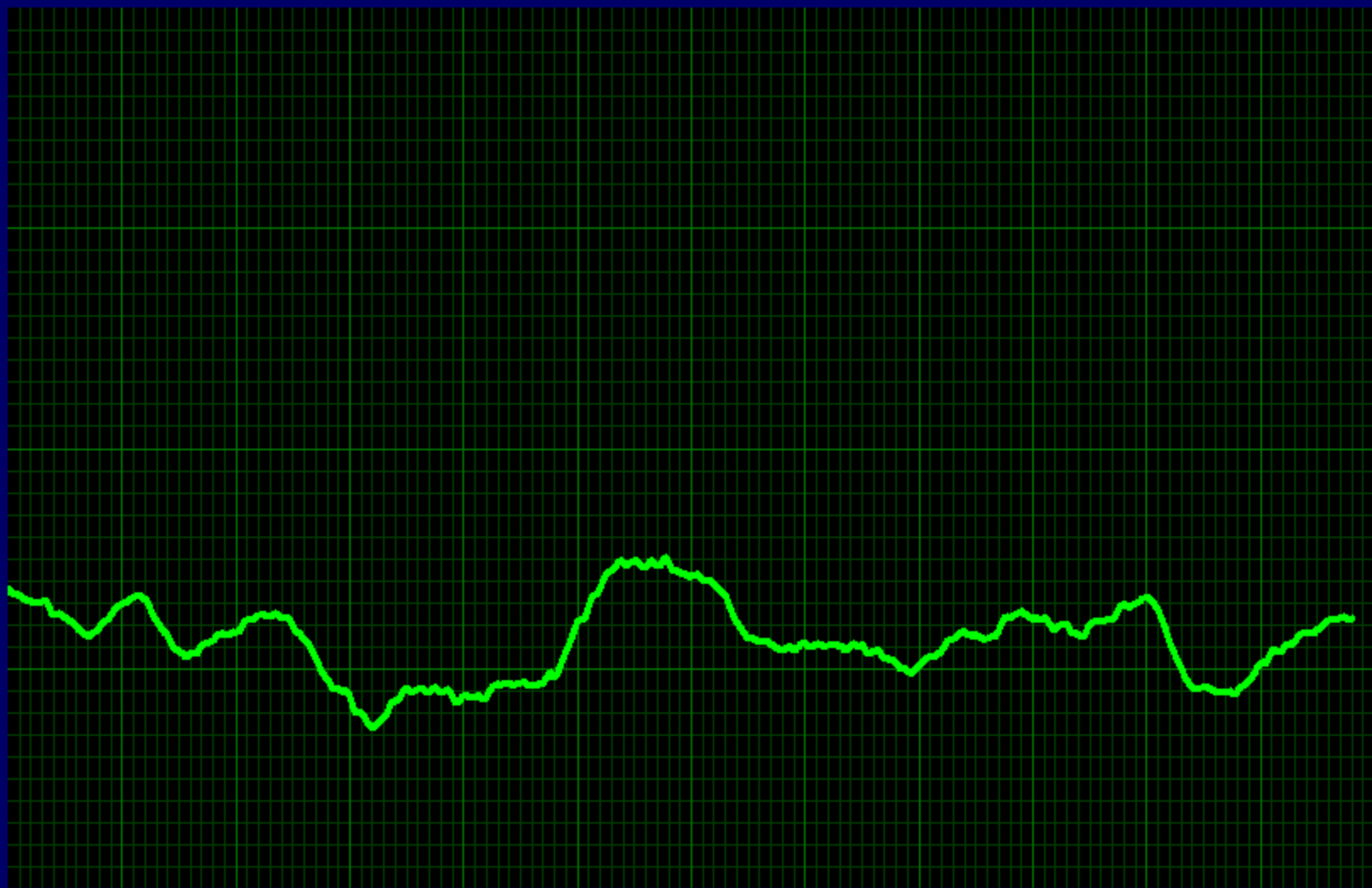
50.2

50.1

50.0

49.9

49.8





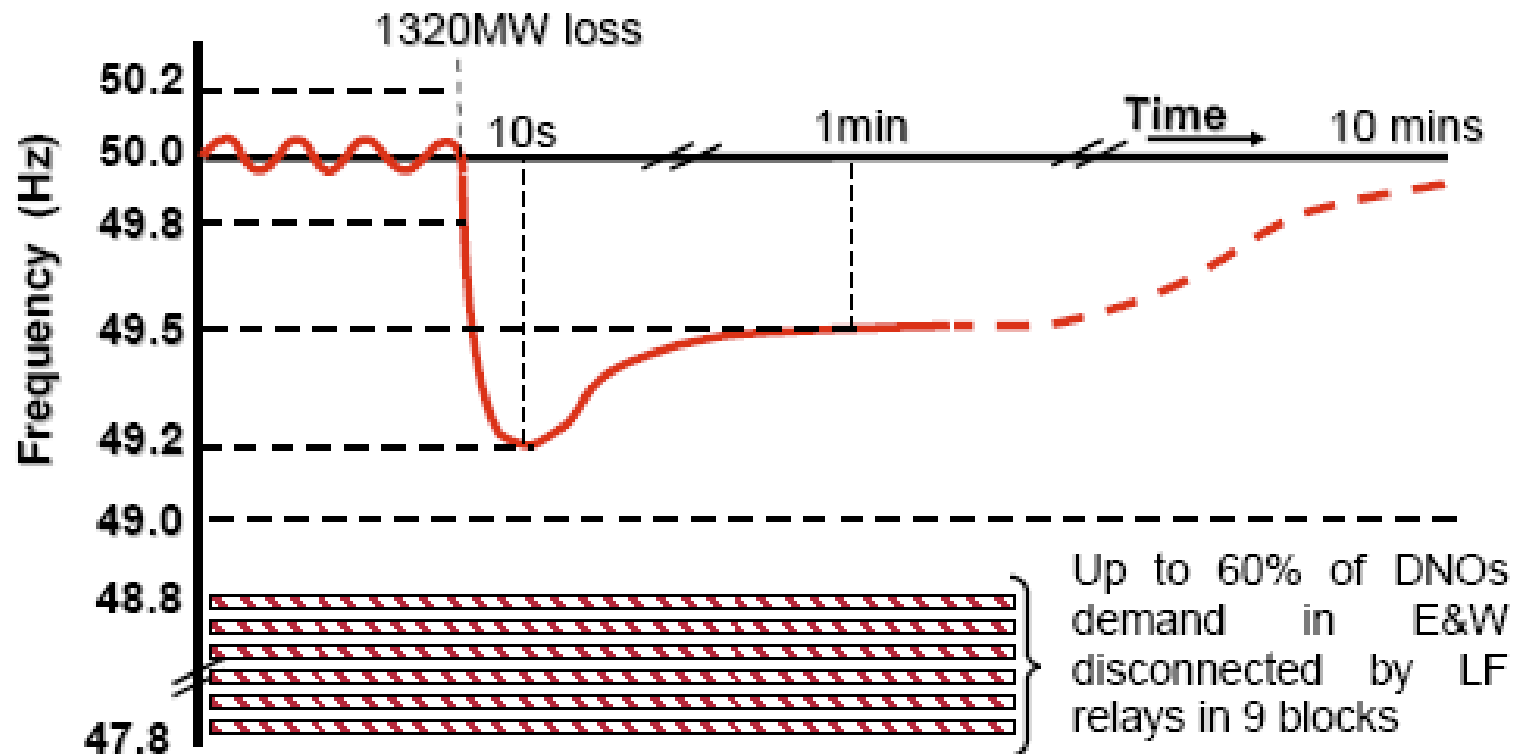
Grid System Management for the unpredictable

- Crises happen – lost plant, lost lines, lost penalties



UK Recovery Objective

GB System Frequency Control and Stability



Demand Flexibility - Fridges

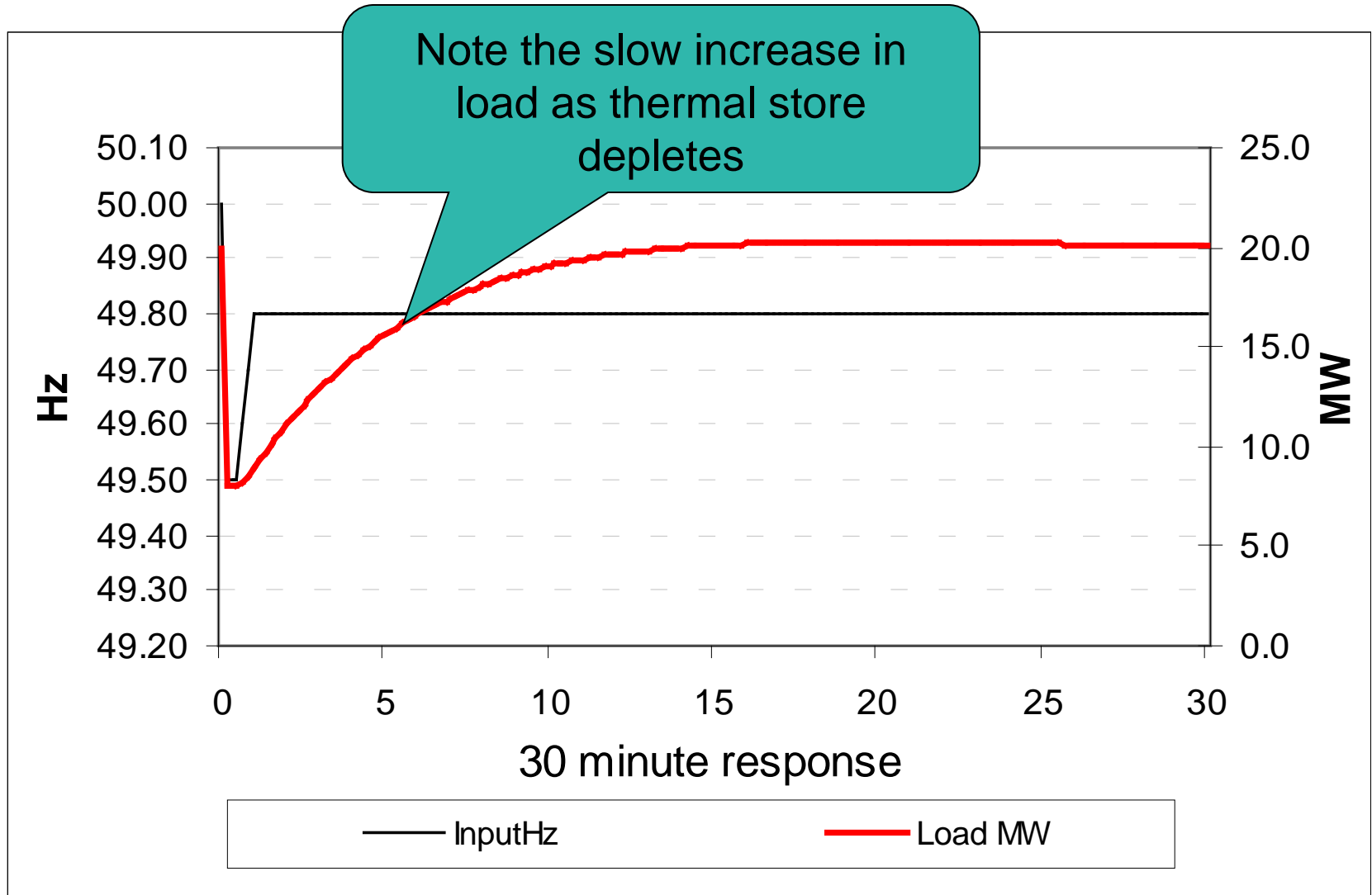
- UK Demand ~ 1.8GW
 - ~3% of peak demand
- Average maximum disconnect ~ 30 minutes
- 900MWh?
- UK Market ~ £200m p.a.
- New fridges are more efficient
- Appliance life ~ 12 years

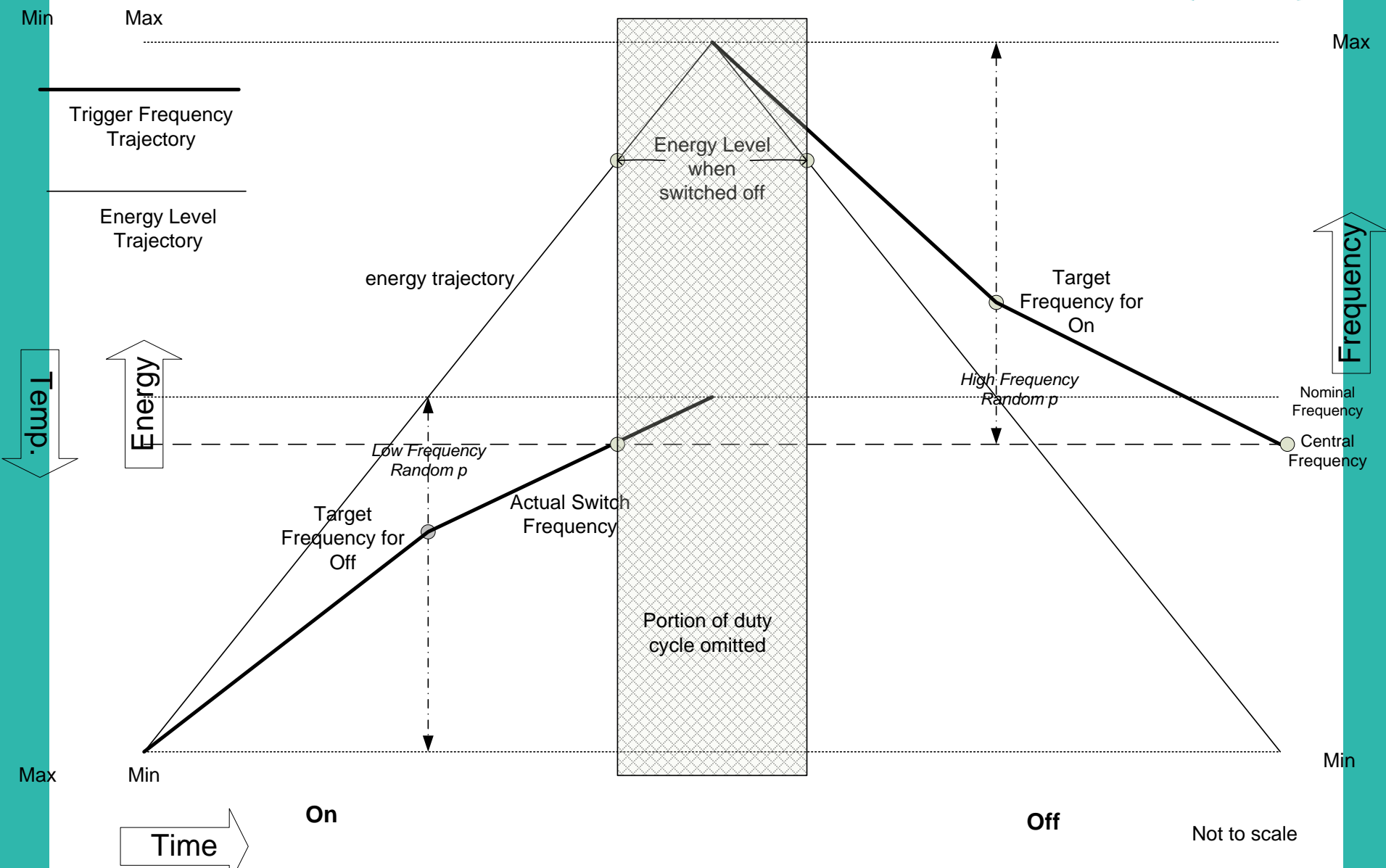




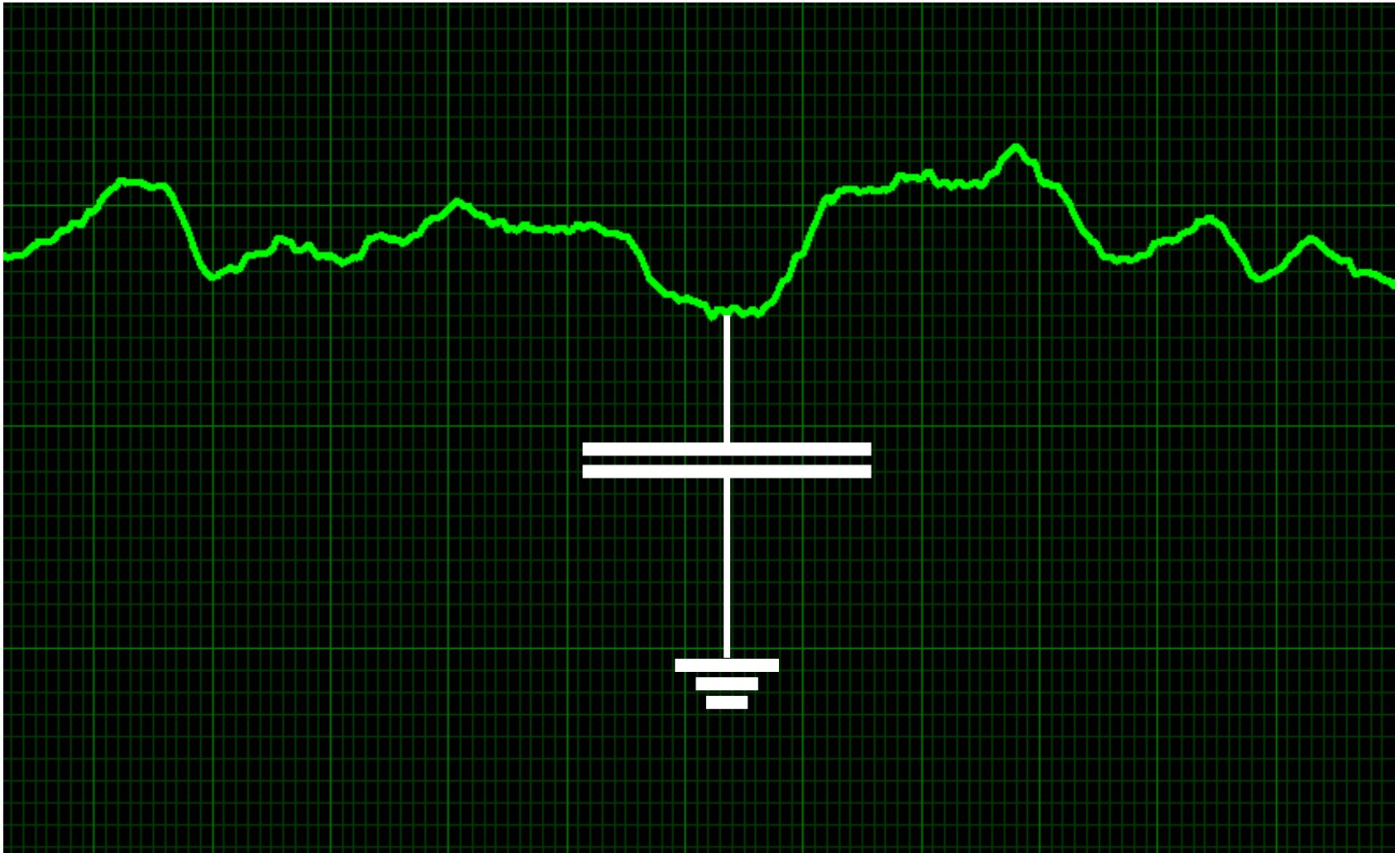
Drop to 49.5 Recover to 49.8
Range 0.8Hz

HSI

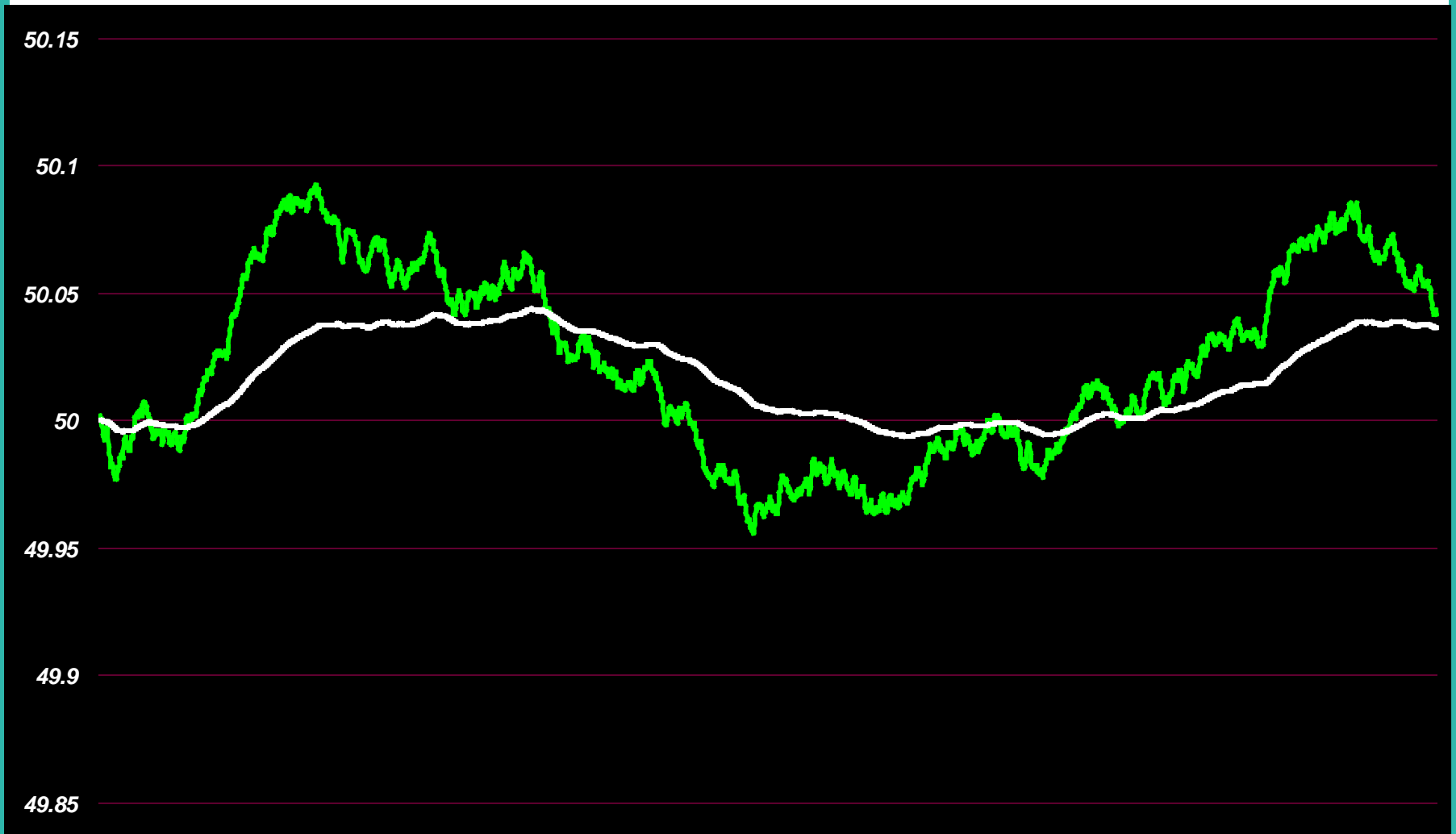




Like a frequency capacitance?



Damped Variation



Frequency Tells Price

- Integration of frequency gives balance of overall energy
 - Energy borrowed by or loaned to fridges
- Clock is integration of frequency
- So state of supply demand “market” in energy is visible to all
 - Slow clock means energy scarce
- Unlike any other market – where high price tells scarcity
- Should Frequency vary the price?
- Yes – but further complexities

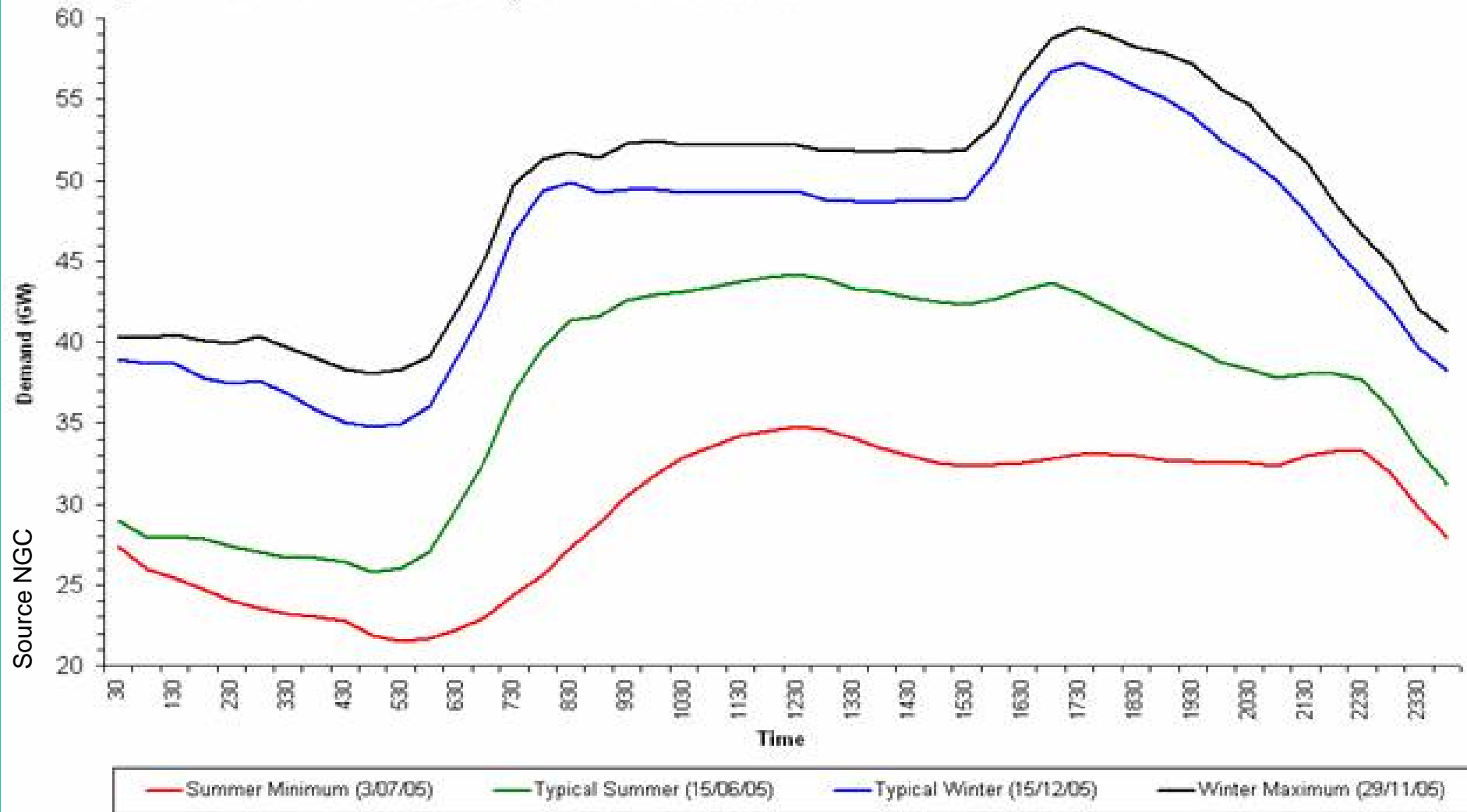
Frequency is a fundamental “real time” price indicator

Electricity

- A core enabler of the later Industrial Revolution and today's living
- Instantaneous Transmission of energy through space – wires and transformers – from generators to consuming devices
- A system utterly without storage
 - Always constrained by energy conversion capability
 - No transmission through time!
- No credible technology alternative to A/C networks in prospect
- Vital change is Renewables not fossil-fuel generation
 - Which is (mostly) timed by nature, not by us

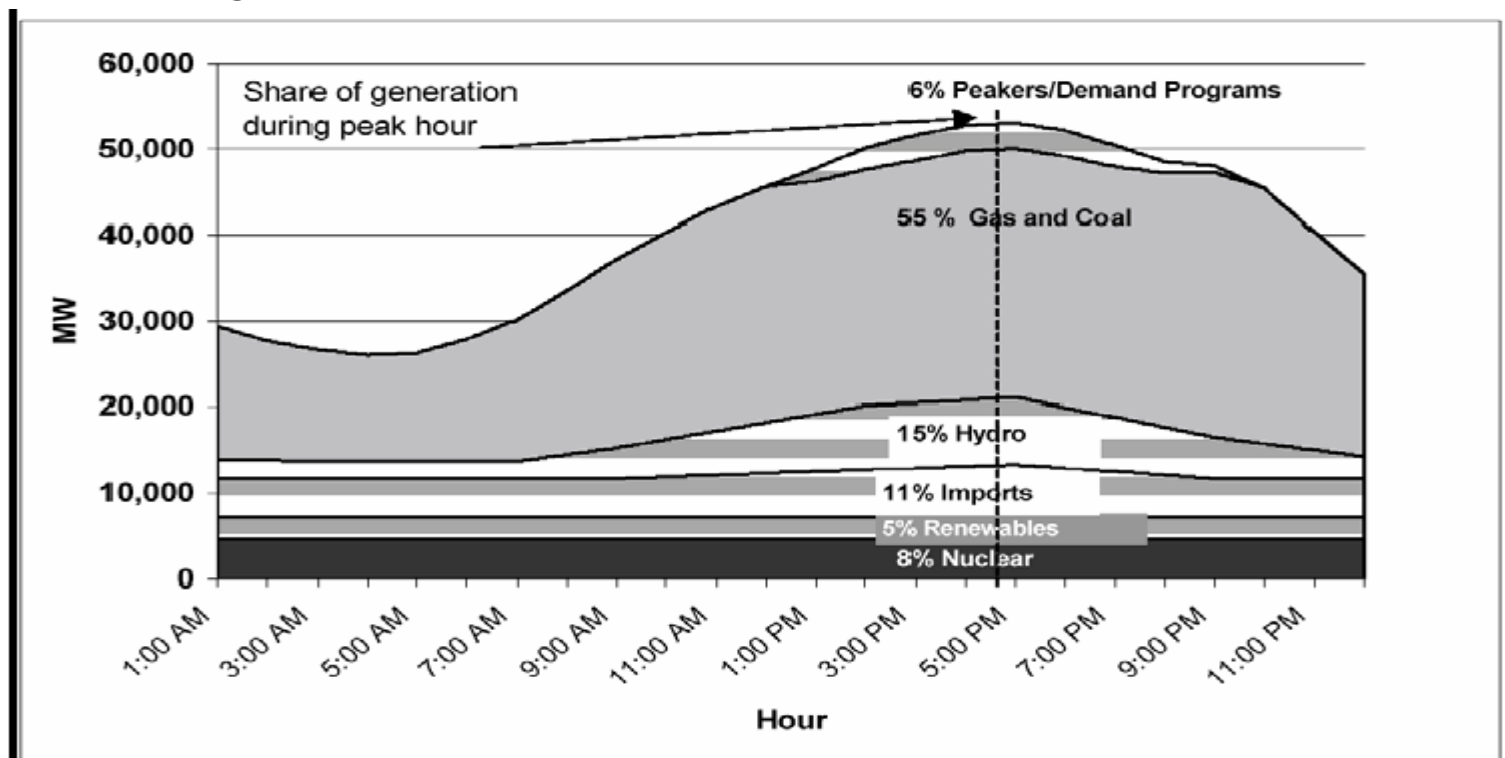
Demand has been Largely Predictable

Figure 2.2 - Summer and Winter GB Daily Demand Profiles in 2005/06



Merit Order

- Schedule plant by Cost
 - But taking into account Constraints
 - Like Speed of change and Transmission
 - Charge SMP





The New Need for Flexibility

- Much renewable generation is uncontrolled, but can be forecast
 - Wind when windy – forecast horizon 1 – 48 hours
 - Wave when rough – forecast horizon 2 – 48 hours
 - Tidal when flowing – forecast horizon – astronomical
 - Solar when sunny – forecast horizon – minutes to hours
 - Hydro when rainy – forecast horizon – months
- Adds up to high variability – albeit with variable predictability
 - Even with Diversity – of source type and Geography
 - Unlike conventional “despatchable” plant – under System Operator control

What has to become flexible?

Flexibility Options

- NOT nuclear – merely intermittent – makes issue worse
- Coal – at a price in CO2 and bills
- Gas – reasonably flexible, and low(ish) capital costs
 - What will be the price of gas?
- Hydroelectricity – only nearly perfect
 - Needs mountains and rain (or snow) – Norway
 - May need pumping
- Demand was considered “inelastic”
 - Nuclear drove Off-peak

Power demand for the day:

March 5, 2012

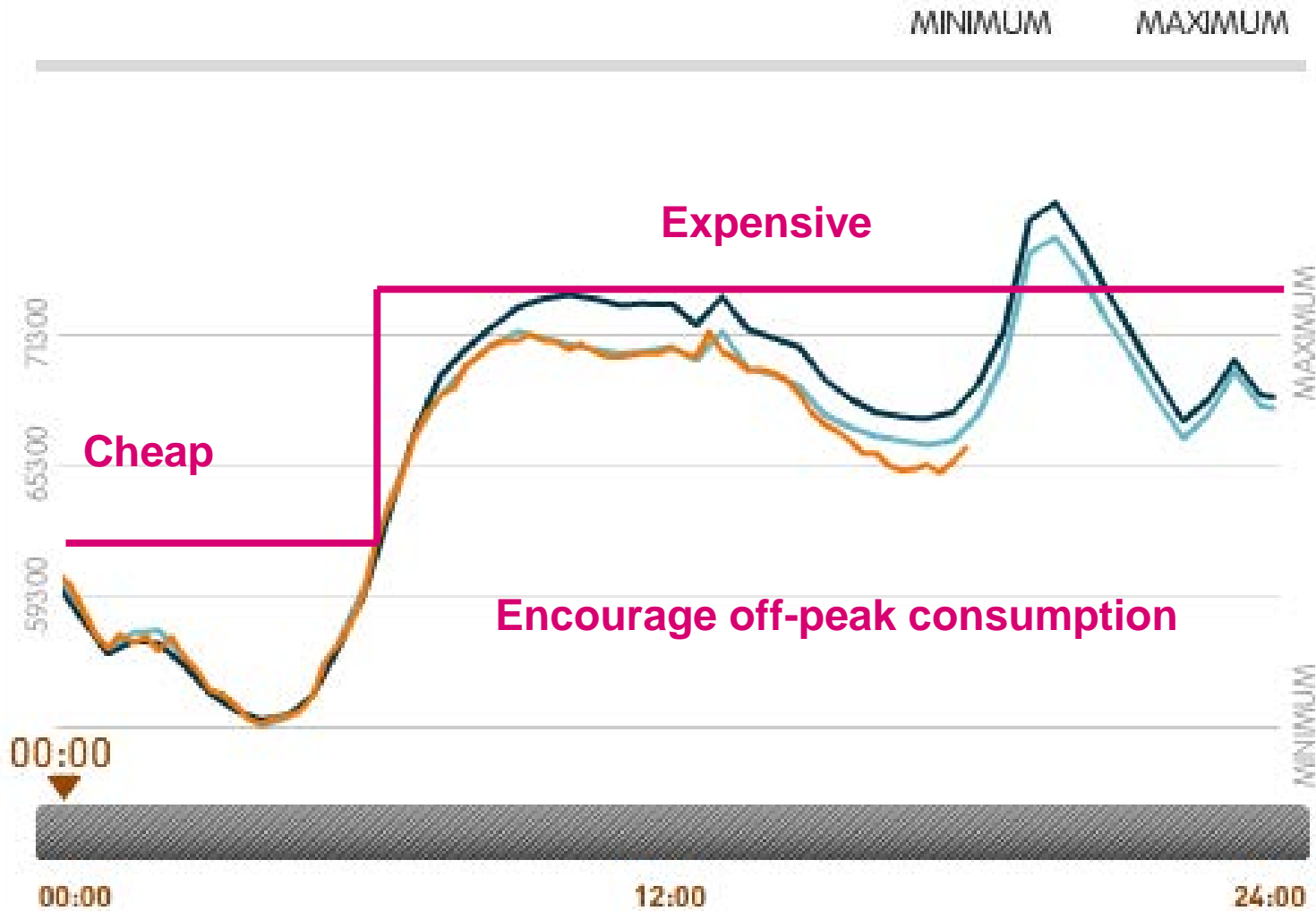


?!.

Compare actual power demand with:

YESTERDAY'S FORECAST

UPDATED FORECAST



There is Flexible Demand

- Wet appliances – flexible deadlines
- Space and Water Heating (and cooling)
 - So long as space is well insulated, so stays warm
 - Gas has inherent storage, so peak demand is cheap
 - Heat pumps can displace gas
- Electric cars. Clearly batteries, but also hydrogen
- Fuel Manufacture. Hydrogen clear candidate, but other hydrocarbons (methanol) feasible
- Probably also avoidance of wasteful peak consumption
 - Floodlighting

**Can demand be made to match
available generation**

Appliance Price Menu

Time Now: 21.30

Completion Time	Cost
10.40pm tonight	£1.50
7.00am tomorrow	£0.50
4.00pm tomorrow	£0.25



Reschedule if price exceeds £0.60

Such a price menu is only likely on a summer night, when sun is forecast for the whole day tomorrow.

Car Charging Menu

Time Now: 18:45

Current Charge 20 miles (15%)

Next trip	Distance	Cost
8.00pm this evening	30 miles	£4.50 (30%)
7.30am tomorrow	50 miles	£4.50 (60%)



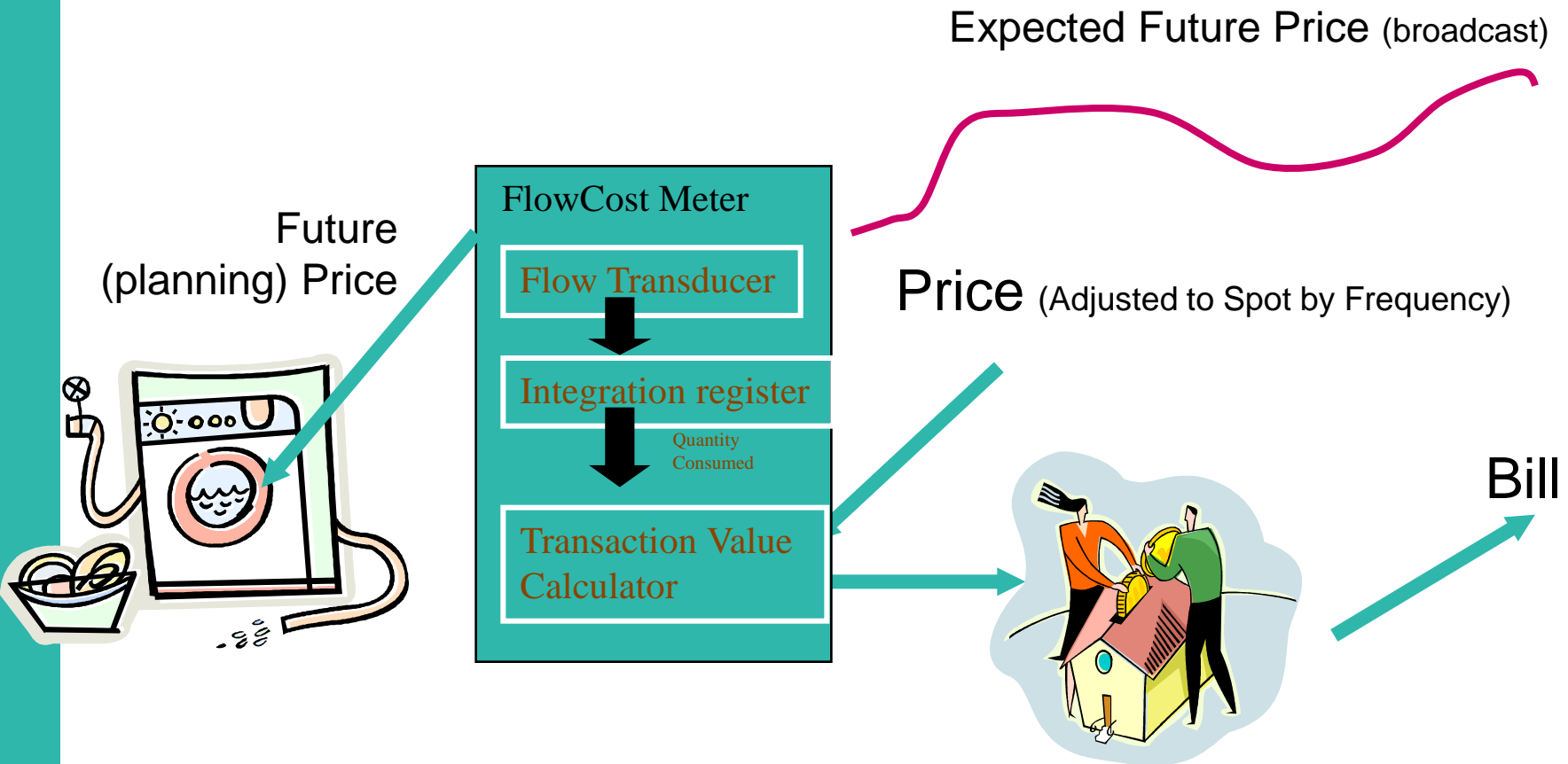
Reschedule if price exceeds £10.00

Full Charge	Distance	Cost
7.30am tomorrow	110 miles	£9.00
3.00pm tomorrow	110 miles	£7.00
1.00pm Saturday	110 miles	£3.00

What should electricity prices do?

1. Vary continuously
 - There are no “natural” discrete intervals
 - Conventional and archaic trading habits & capabilities impose constraints
2. Vary quickly – consider the scenarios
 - After a big genset failure, price changes within seconds, and hangovers last days.
 - When a storm front passes the systems moves from surplus to scarcity within minutes
3. Adjust to frequency

Smart Prices Approach



Key Opportunities

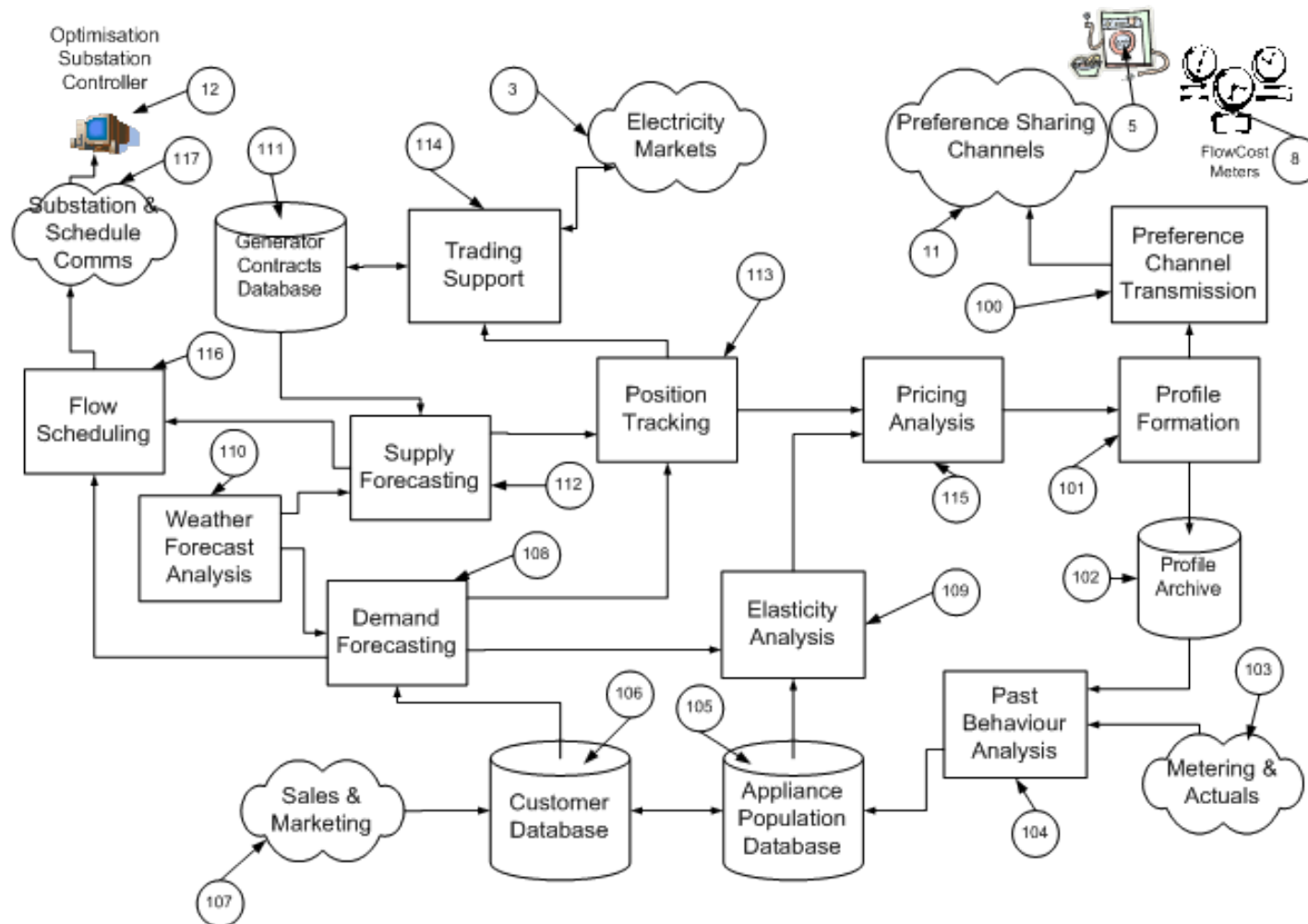
- Low cost broadcast communications
 - Price information passed rapidly to all participants
- Selective Rollout
 - Flexible users and early adopters
 - Bundled with devices – appliances, cars, Heating systems
- Demand can play in Balancing Mechanism
 - Guaranteed Demand Response
 - Peak demand reduction – lower costs

Demand Matches Supply

- When Wind (or sun) is forecast, then suppliers will decrease prices
- When prices decrease, then more appliances will run

**You (or your appliance) does your
Laundry When the Wind is Blowing**

Retail Price setting will need to be sophisticated



The Smart Grid approach

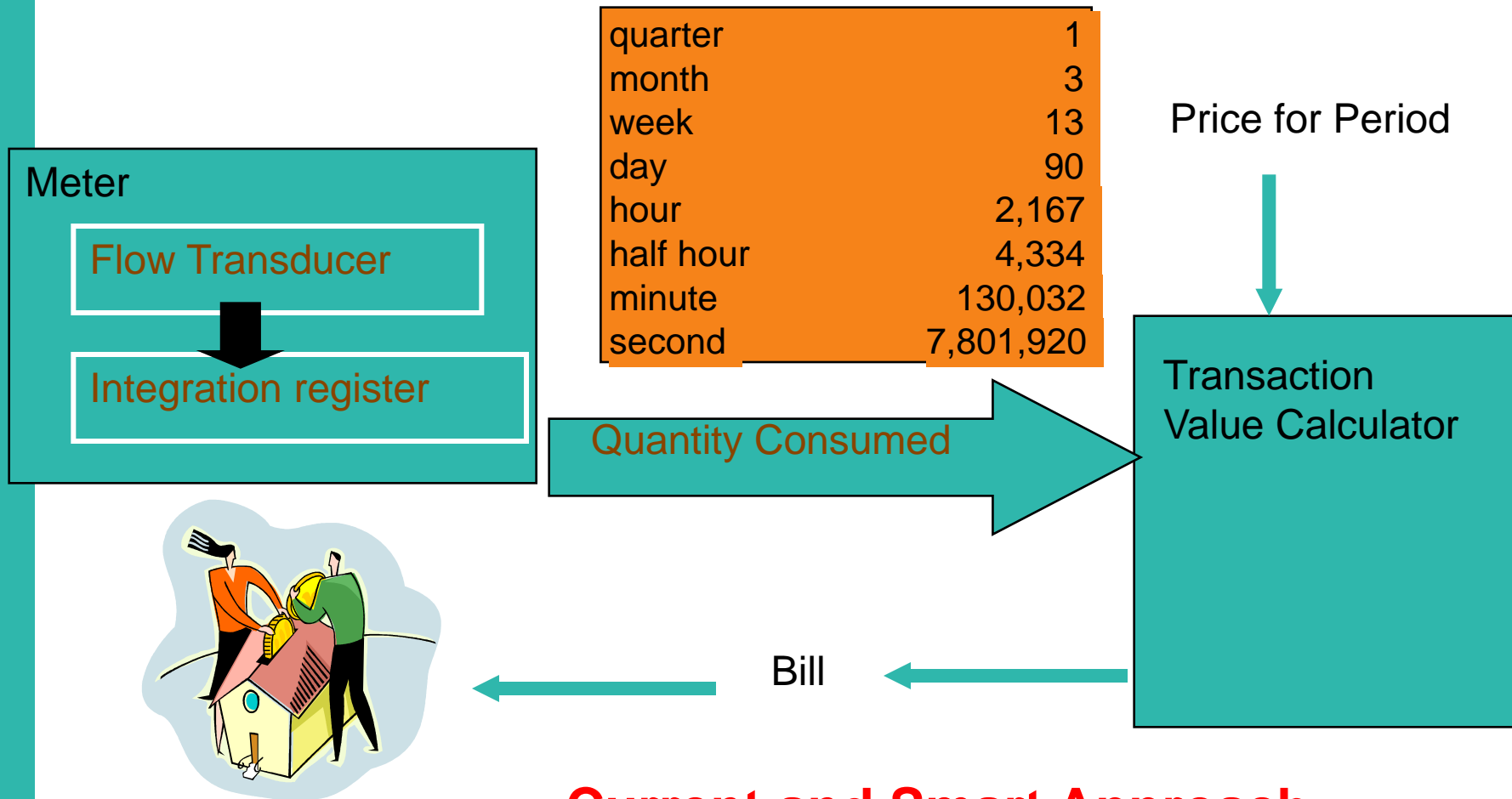
- Make everything intelligent (including you!), and connected to the internet – the Internet of Things and Cloud approach
- So System Operators can monitor and control everything

But

- Need Aggregators of many users to create Virtual Power Stations for SO
- Who can trade your flexibility in wholesale markets
- For discounts to you
- At risk of flat car, dirty dishes, cold water, ruined clothes
 - When you forget to tell them

There is no compelling consumer vision

Meter Data Flows & Processes



**Current and Smart Approach
Not fit for purpose**

“Smart” Meter Programme

- Multiple Registers, so more choices of flat tariffs & timing
- HCI – so you are informed (approximately)
- Separate secure network; Fiscal & Privacy demands
 - Remote switch off!
- Universal enrolment even when no flexibility
- Central (monopoly) Data Collection Comms
- Vast cost - £11 billion

VILE Oligopoly further dominates

Economics and Competition

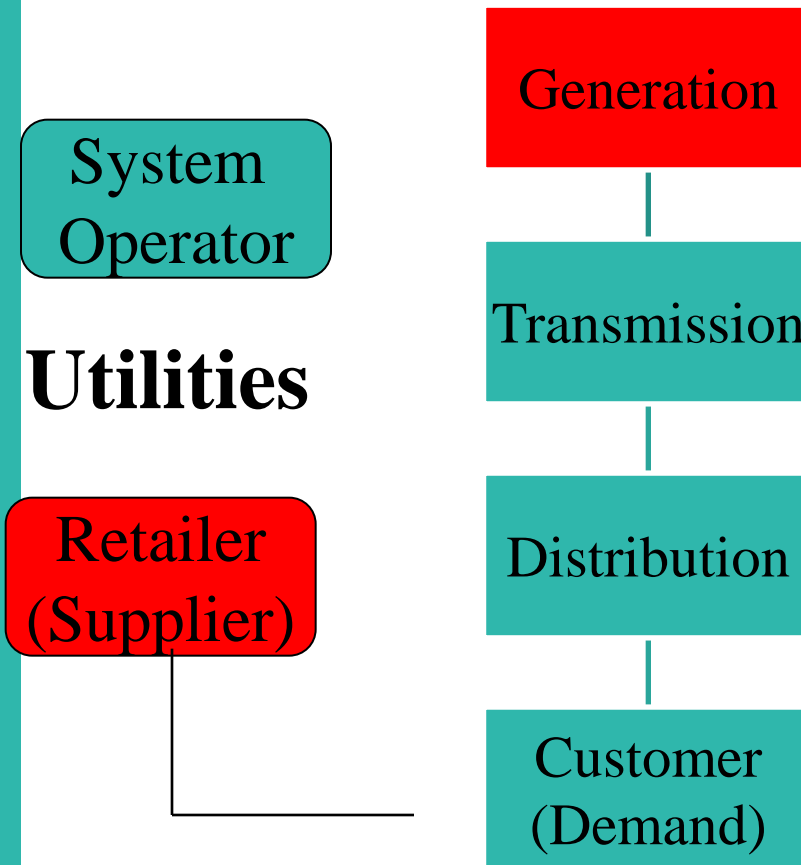
- Social utility is maximised when prices reflect marginal costs
 - Sellers maximise contributing sales
 - The maximum number of buyers benefit
- Commodity market competition discovers marginal costs = prices
- You cannot make a living selling at marginal costs
 - Without scarcity there is no profit
 - Merely optimises the use of existing infrastructure
 - No profit for investment
- Business seeks discriminatory pricing
 - Those who can afford it, and wish to, pay more for cheap extra benefits
 - Like status, branding, convenience
 - Or confusion?

Competition and Electricity

- What is the marginal cost of Electricity?
 - At peak times?
 - At low load times?
- What is the marginal cost of connection?
 - At a farm; at a stately home; at a suburban villa; at a flat?
- What discrimination is fair?
 - Bigger buyers get the best deals
 - The poor pay most
- What innovation is possible? What do we want?

Climate Change Mitigation

Electricity Supply Industry (ESI)



- “Deregulation” separates functions
- **System Operator** (and usually Transmission Operator) remains a statutory monopoly
- Wholesale competition among generators (who sell to Retailers)
- Distribution monopolies for each geography
- Competition among Retailers (known as Suppliers!) for customers
- Overseen by Regulator (Ofgem) & DECC
- EU now has ENTSO-E

NETA / BETTA Evolution of Markets

- Well-ahead Bilateral and Exchange **Wholesale** Trading between GenCos and Retailers
 - Scope for long term contracts?
 - Trading result should be SMP, but costs not revealed
 - What about zero (or negative) marginal price?
- “Gate closure” when SO notified of contracts and despatch plans.
 - How far ahead? 1 – 1.5 hours. SO to plan reserve etc.
- BM (Balancing Mechanism) for near real time and balancing trading
 - System Operator buys or sells using BM bids & offers
 - Almost exclusively from Generators
 - Costs passed to settlement
- Settlement amongst retailers “deemed” by “profiles” of statistically average consumers. Not actually measured
- NETA (New Electricity Trading Arrangements), extended to (BETTA) British Electricity Transfer and Trading Arrangements

Issues with BETTA

- No reliable “Spot Price” or Index – no long term contracts
- Retailers load (inevitably) differs from predictions (and so contracts), so they face unpredictable (and unmanageable) BM costs (to profit of generators)
- Favours despatchable generation & assumes predictable loads
- So Vertical integration (generators buy retailers & consolidate), and VILE Oligopoly
- Rewards market trading skills – bankrupt inflexible nuclear
- Retail competition leads to explosion of (incomprehensible) retail tariffs (bamboozlement)
- Renewable generation disadvantaged because uncontrolled (and harder to predict)
- So subsidised by obligations on Retailers (=regressive tax)

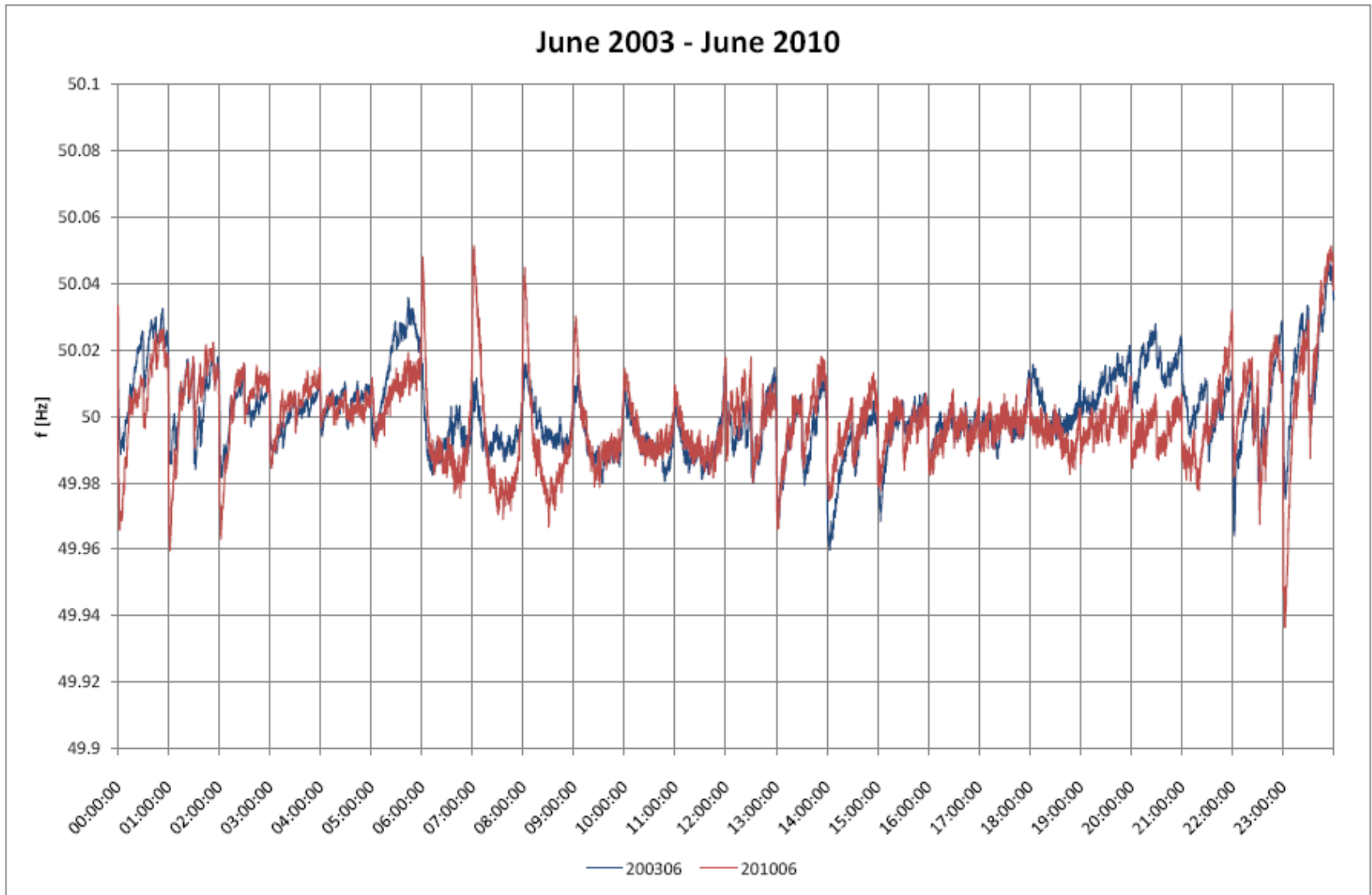


Fig. 3.1: Average frequency values in Continental Europe, June 2003 and June 2010, Source: Swissgrid

Settlement

- All contract notifications, BM trades and all wholesale meter readings fed in
- Each half hour all consumption allocated to retail meters, and so allocated to retailers, based on
 - Statistical Profiles from of intensely measured samples
 - Historical consumption
 - And adjusted later in the light of actual meter readings
- BM Trades are allocated to retailers using
 - Variance of notified contracts and deemed allocations
- So Retailer initiative towards influencing consumers:
 - Creates greater variance, which increases their costs
 - Benefits every other retailer – a perverse incentive

The Perception of Competition

- With fast changing, unpredictable prices, it is effectively impossible to accurately measure the consumption attributable to retailers selling via a shared infrastructure
- Arguing about the deeming algorithm is a zero sum game, of no benefit to consumers
- Changes to deeming algorithms have to be agreed by all stakeholders, and then implemented – who pays for this? Who gains?
- So all retailer offerings fundamentally the same
 - Except the colour of your bill!

Better focus on fair governance of (local) monopoly (& HVDC to Germany)



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Thank you

Questions?

For further collaboration contact david@davidhirst.com

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