

Discussion



Analyzing Energy Transition

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7 March 2018



Methodology

- Fundamental Question
 - “What are the dynamics, drivers and consequences of transition in energy markets”
- Limited number of questions
 - What history says
 - What is the extend of technological effect
 - How actors are dealing with the transition



Warming up



Question 1

- Is iPhone disruptive?




Question 2

- Are electric cars disruptive?



Question 3

- Are lithium batteries disruptive



Analyzing the “Transition”

Rules

- Technology distorts status quo, changes price expectations
 - Fracking&horizontal drilling technology in US
- If it is incremental technology, it makes the system more efficient
 - LED lighting vs Light bulbs
- If it is disruptive technology, it distorts CAPEX (Capital expenditures) as well as OPEX
 - Shale in US, changed the investment dynamics

Time & Timing

- The temporal effect of transition
(over estimate in the short run, underestimate in the long run)
 - Solar PV panels are not a new technology
 - Lithium Ion batteries were known and used in mobile technologies
 - Electric cars were known since early 19th century
- “Oil prices will drop” vs “Oil prices will drop in two weeks time”



Historical Evidence

- Timber Famine
 - How timber famine led to new building materials (but took some time)
- Whales
 - Sperm whale oil, population dynamics, coal and then oil refining
- Geopolitical shocks

Speed of Transition

- Atoms are under intense regulation, but bits are not
 - Can do a website in minutes, invent a business model in months
 - Cannot invent a product and sell it in “months” (Extensive regulation, health&safety)
- OLED, LED TVs
- Was 20th century coal or oil century?



Supply or Demand Driven

- Basic chicken-egg problem?
- Does supply drive demand or demand drive supply?

Answer is

- Initial transition starts with “supply”
- Supply-supply chain-pricing mechanisms-market
- This is true for coal development in US
- Same for PV
- EV?



Actors

- Misrepresented Kodak example
- Actors see the change, but they are not running the show anymore
- Since a new technology is introduced, everyone's experience is 0.. Do not need consultants for some time
- Ex: Blockchain

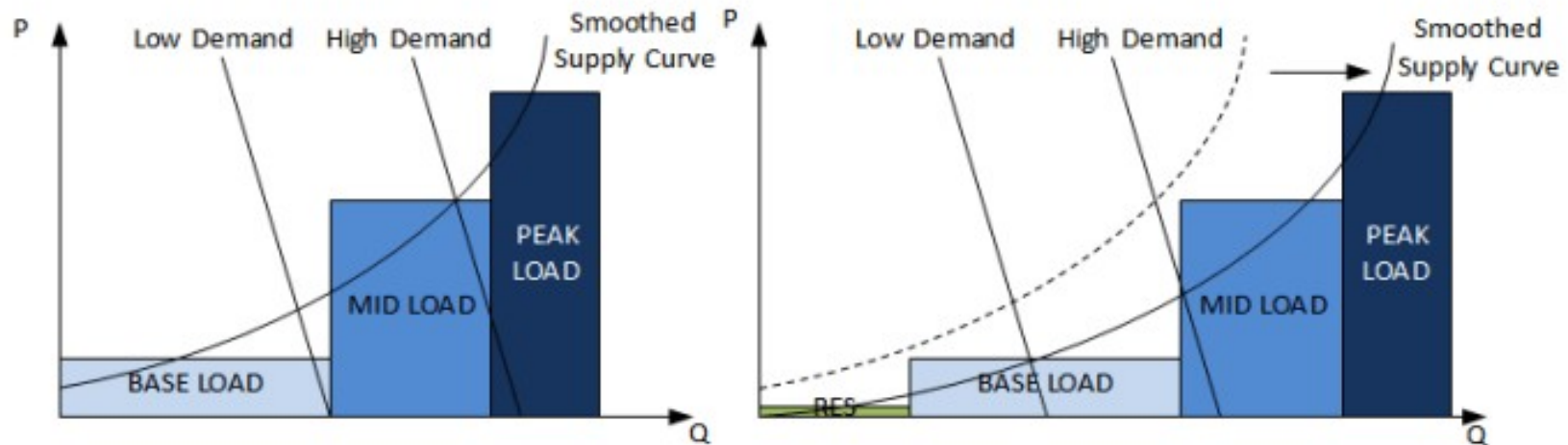


Transition in Electricity Markets

What is the fundamental questions?

- Do consumer want this transition at all costs?
- Energiewende or other Ren. Transitions might cost less
- “Technology drives regulation, but regulation should not choose specific technology”
- Ex : Autonomous cars
 - Why is it happening
 - Where is the regulation for autonomous cars?
 - How to get permit?

Peculiarity of Electricity Markets



- Supply chases demand
- Demand does not bother flexibility
- All flexibility is required from supply
- Why? NO STOCKS

The design flaws

- Central buyer optimizes supply and demand through a mechanism called merit order
- The theory says that, as you become more efficient your margins improve (variable cost competition)
- Enter the renewables
 - Variable cost of solar : 0 (But LCOE: 3-5 cent/kWh)
 - Variable cost of wind : 0 (But LCOE: 5-7 cent/kWh)



The technological change

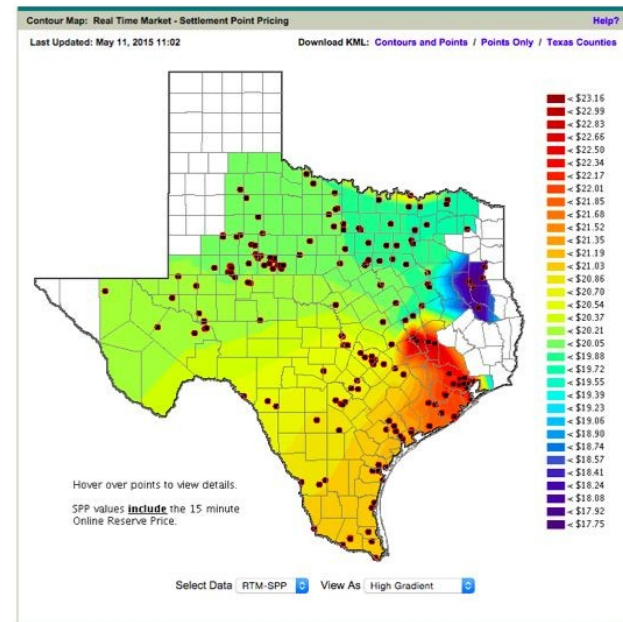
- Consumer
- Prosumer (Producer+Consumer)
- Prosumerage (Producer+Consumer+Storage)
- Smart Grids “in Transition”
- Digitilization
- Electrification of Transport
- AI

Digitilization

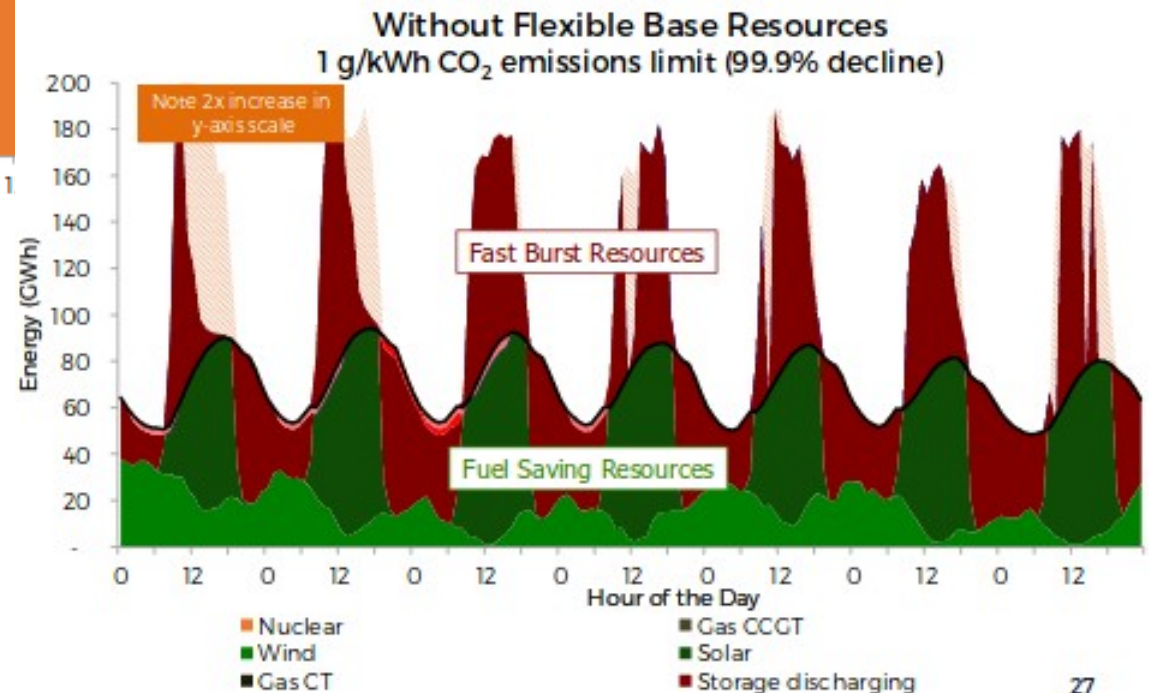
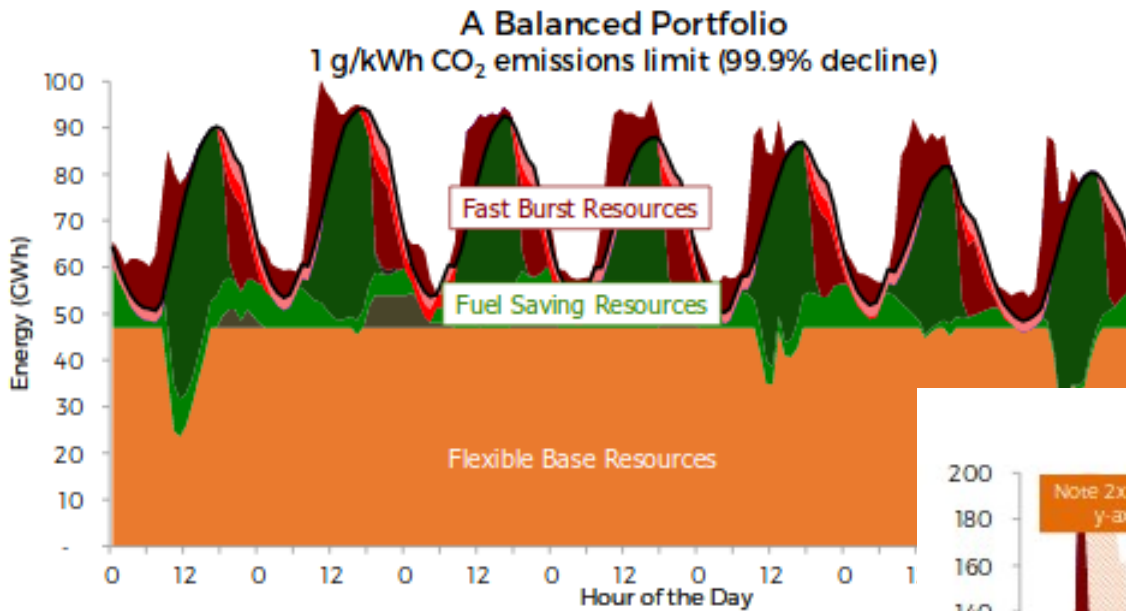
- Is it a new phenomena? Or rebranding
 - Smart grid, industry 4.0
- Digitilization was present since 80s&90s
- What has changed?
 - Costs dropped (just like solar)
 - Workforce adapted (cheaper)
 - Digital economy multiplied

The first equation to be solved

- Pricing & Cost allocation
- What has happened to telephone land lines?
- What is the sunk cost (esp. in developing world)
- per/minute → bulk pricing
- Spatial and temporal pricing



Investment & Security of Supply

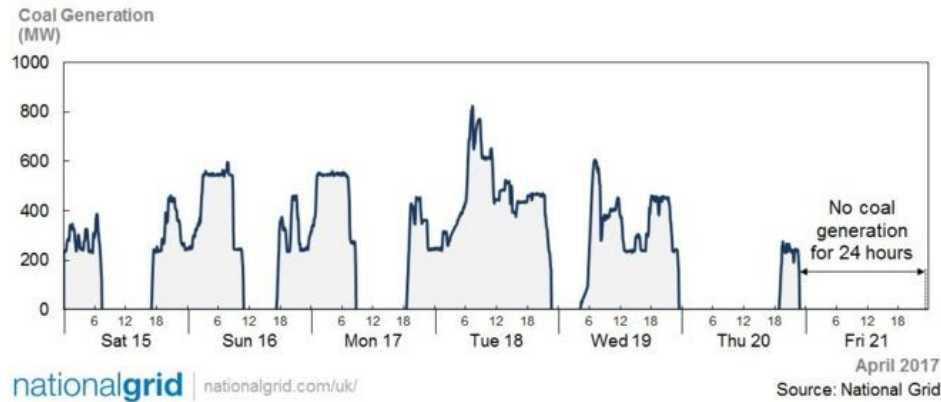


Transition in UK

- No Coal

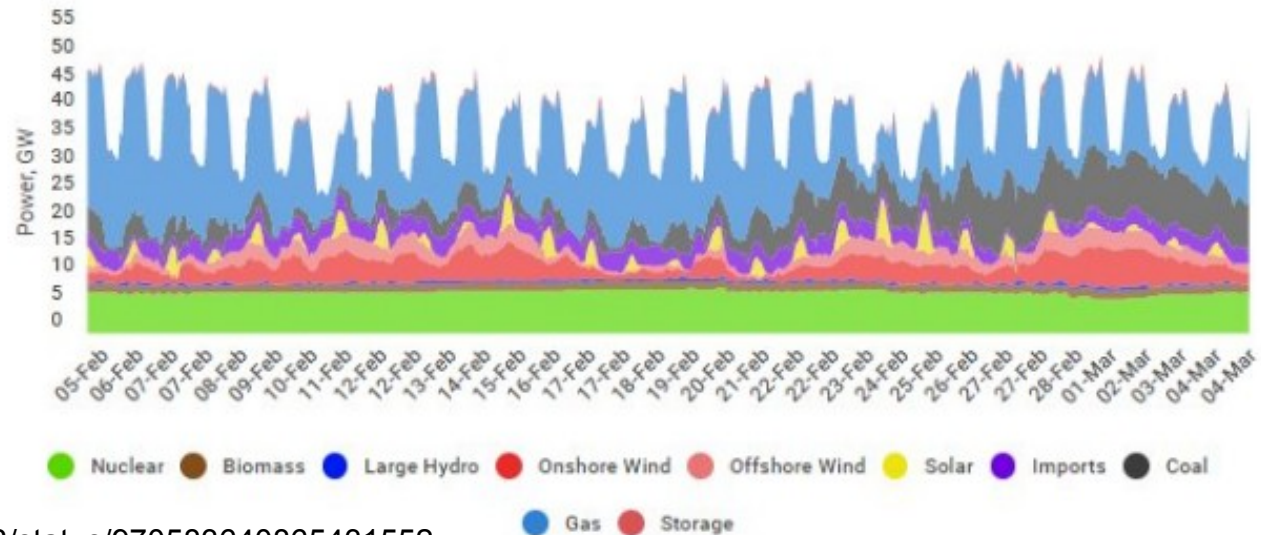
Great Britain goes without Coal Generation for 24 hours

Friday 21st April 2017 was the first 24-hour period since the 1880s where Great Britain went without coal-fired power stations.



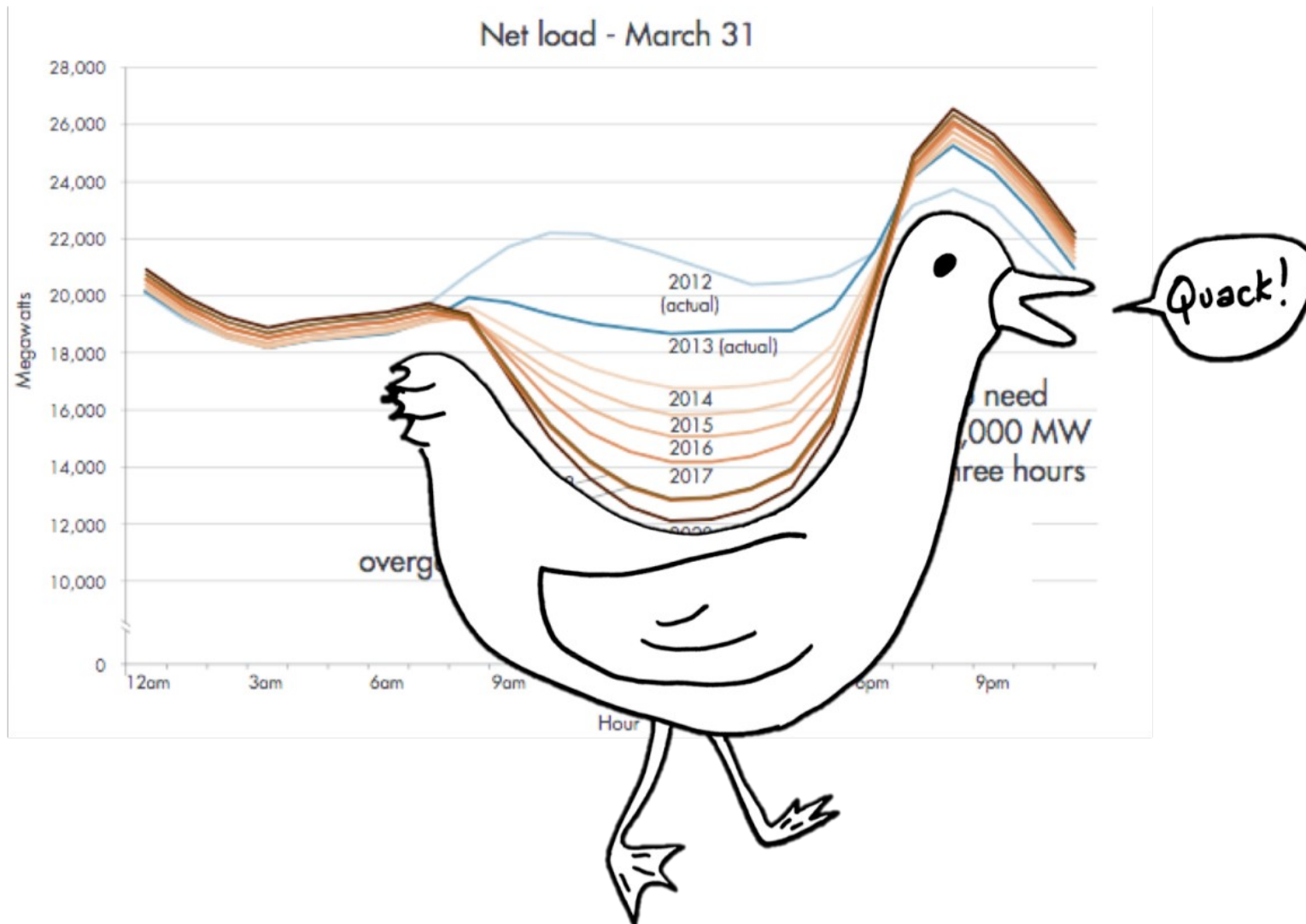
Hourly electricity generation over last 28 days

Electricity generation in Great Britain, every hour for the last 28 days. Note the solar peaks and the way that generally we have long periods of strong wind followed by periods of low wind.



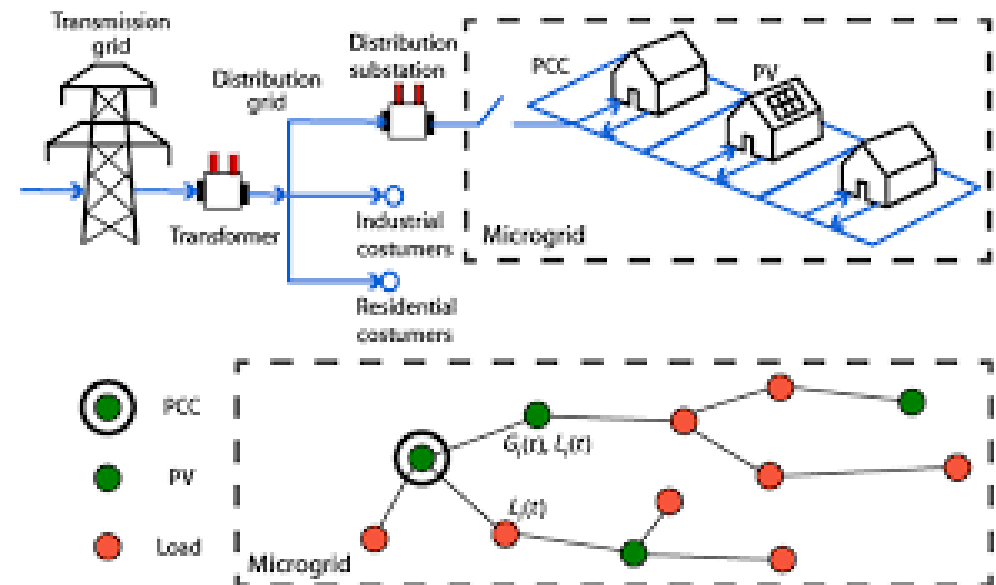
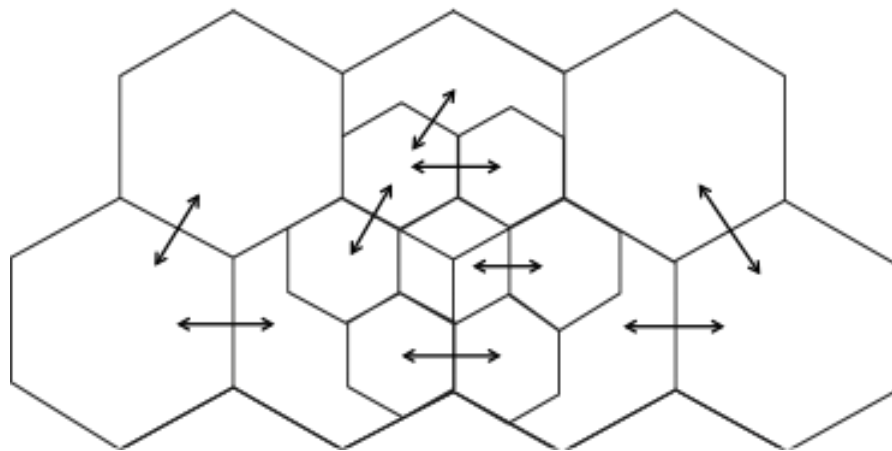
- Coal

Duck Curves



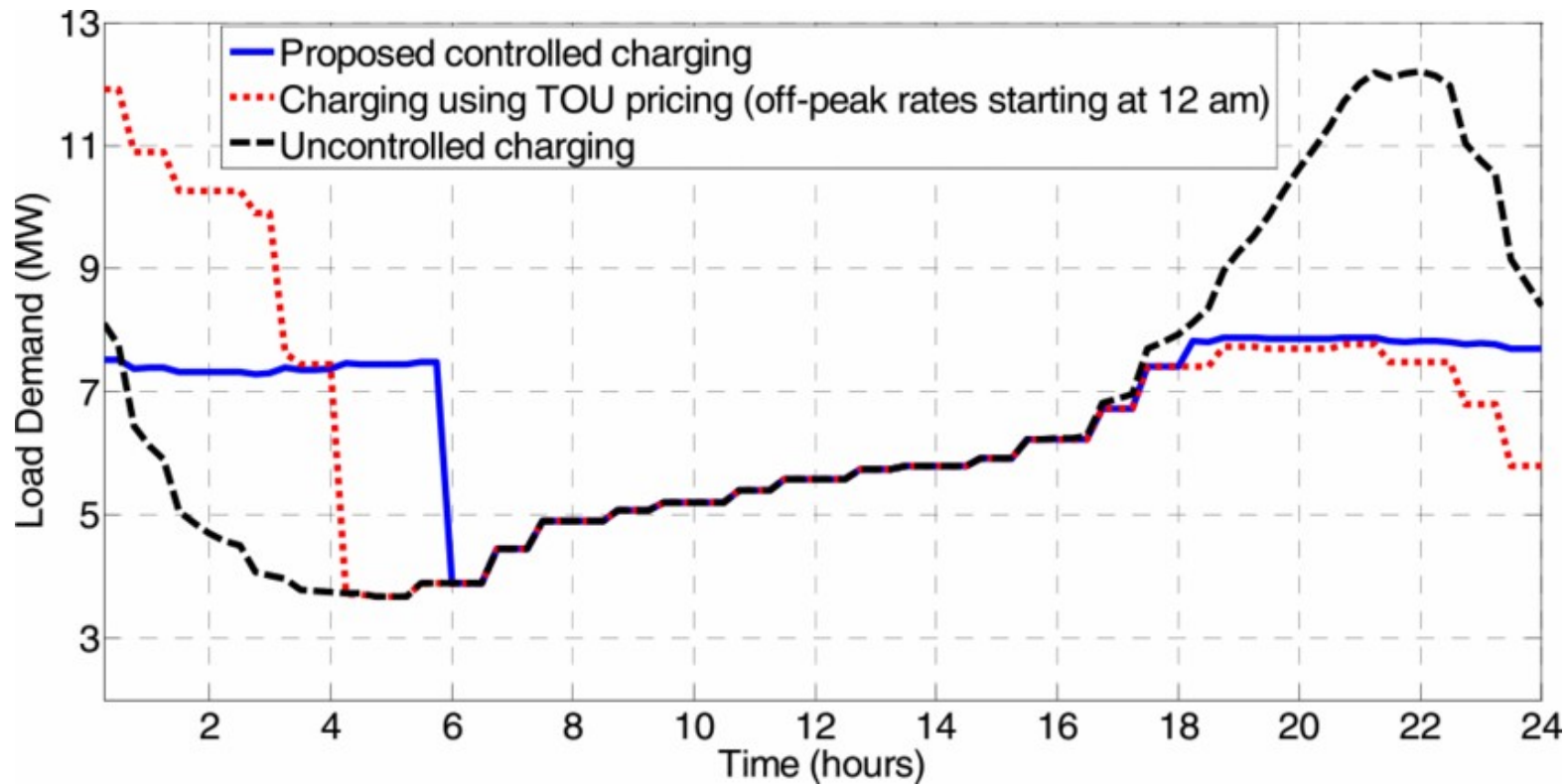
Microgrids & Blackouts

- Competition between Economies of Scale and Economies of Scope



Electric Cars

- Brilliant for Utilities (Increases CAPEX)



What history says?

- Transition may be slow & costly. But it will happen
- Actors had to change
 - DNO → DSO
- The pricing mechanisms need time to settle
- Its impact will grow with time
- Cost effective conventionals will survive
- Markets will change for better or worse

Actors

- New Actors
 - Shell → Utility
- Evolving Actors
 - DNO → DSO
- Actors in turmoil
 - Conventional generation assets
 - States
 - Regulators

New definitions

- Market place
 - consumer \longleftrightarrow producer
 - Prosumerage $\leftarrow \rightarrow$ Prosumerage
 - Exchange & Microgrids
 - Capacity and flexibility remunerations
- Price
 - Not one price but several prices



Limits

- Physical change takes time
- How to make competition among 100 solar panels
- Summer-winter solar day difference in North Hemis.
- Interseasonal storage requirements
- Competitive renewable markets (not tenders!)
- New Security of Supply signals



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