Energy Use in the Media Cloud: Behaviour Change or Technofix?

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Our Question….

- Consuming media online requires energy.
- Can the likely future demand for online media be met in a sustainable way through energy efficiency advances…
- … or will techniques to change people's behaviour and reduce their level of online media consumption be needed?

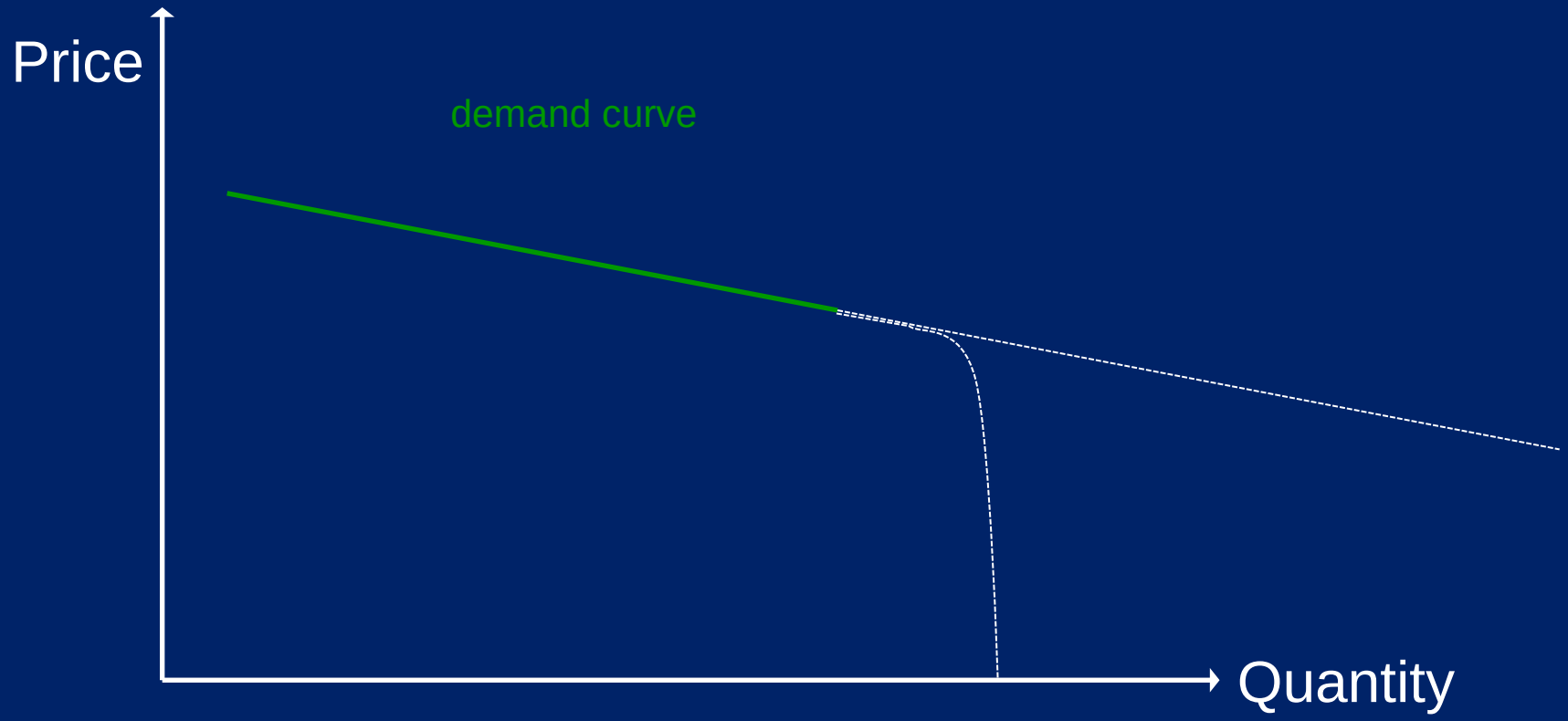
Cloud Energy Use – Two trends…

- Provision of datacentres and network connectivity is becoming increasingly energy efficient…
- But demand for downloaded data is going up rapidly.
- Taylor and Koomey(2006) estimate energy consumption has been increasing by 14% per year, while internet traffic has increased by 50% per year.

Energy reduction goes alongside cost reduction

- Individuals use more of the service
- More people get access to the service
- Innovation is stimulated, finding new ways to use the service.
- All these increase demand….

Two possible futures….



Where is this demand coming from?

- Majority is media consumption (Video, Audio, Images).
- Business traffic is around 20% of total, and expected to grow slower than consumer traffic.
- Hence media consumption is the main driver of internet growth.

(Cisco VNI Forecast)

A possible upper bound on demand - 2030

- All media consumption (TV, Audio, etc) takes place online.
- The emerging Global Middle Class consumes media in a similar way to US/UK population.
- Video consumption takes place at current HDTV standards.
- This gives 3200 MB/day per person, resulting in 2570 Exabytes per year by the global population.

What will the power requirements of this be?

- Estimate of 2010 energy requirement: 4Wh/MB

- Two sources:
  - Extrapolation of Taylor and Koomey (2007)
  - Independent data from the UK hosting company Memset gives an estimate of 4.87Wh/MB

- Global energy consumption by datacentres and internet infrastructure of 10300TWh/yr.
  - Average power draw of 1175GW.
  - About 18% of expected world power capacity in 2030.

Can we meet this sustainably?

- The US DoE estimates world renewable energy capacity in 2030 to be 1935 GW.
- If we allow datacentres and internet infrastructure 1% of that, then it means we need a 60x improvement in energy efficiency to come within this target.
- For most industries, such a target would be near-impossible. (e.g. transportation).
- But if the performance improvements noted by Taylor and Koomey continue, this would be achieved by around 2021

Caveats:

1. Moore's law may cease to hold…

2. Humankind is remarkably innovative, and may well find ways of increasing the demand for bandwidth by further orders of magnitude…

- Larger and even higher definition TVs; HiFi quality audio feeds.
- Home video installations. Always-on 'windows' to friends.
- Lifelogging.
- Wide adoption of personalised immersive entertainment.

Reducing Demand for Media Download

1. Digital Waste: Eliminate downloads which are not actually consumed

   e.g. Podcast service which spots old subscriptions no longer being accessed.

2. Persuasive Design: Encourage less data –intensive consumption

   e.g. Video link for an interview at the bottom of a transcript.

Reducing Demand for Media Download

3. Raising awareness of usage

   e.g. Real-time feedback regarding amount of energy/carbon emissions associated with downloading.

4. Reducing Peak Demand

   e.g. Caching of songs at low demand times for insertion into real-time streams at periods of high demand.

Further work

- Make the analysis more complete:
  - Impact of Mobile Networks
  - Energy used to manufacture/decommission network devices and servers
  - Impact of end user devices of different kinds

- Estimate the energy reduction potential of the different strategies for demand reduction.