End of demand growth?
Why such a scenario is not as far-fetched as it sounds

UNSW Seminar
19 June 2012
Sydney, Australia

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Thank you

Pleasure to visit UNSW again

Wish to thank Iain for the invitation

Opportunity for debate
My main message
And topic of forthcoming book

- **Energy demand growth anemic**
  - Can be further adjusted downward within OECD
  - Non-OECD countries will eventually reach same stage
    - More important: Demand growth *can* be modified/influenced
    - Feasible, cost-effective & desirable to reduce growth

- **Focus on electricity**
  - No growth scenario *not* far fetched

- **Implications?**
Book project

- Forthcoming Jan 2013
- Devoted to “End of Demand Growth”
- Examines EE hurdles
  - Regulatory: Incentive to sell kWhrs
  - Policy: Focus on supply, not demand
  - Pricing: Flat prices that do not include all costs
  - Behavioral: Changing consumers’ mindset
- Case studies
Evidence of “demand saturation”

Influencing demand
- Markets or mandates?
  - Codes & Standards
  - Regulations & mandates
- Prices & consumer behavior

Wrap-up & discussion
1: Demand saturation?
Too many cars, not enough drivers
Vehicle ownership per 1,000 people, 1970-2030

Source: BP Energy Outlook 2030, Jan 2012
What is the evidence?
"End of demand growth"

Consider one example
- US petrol consumption has peaked
  - Will never reach or exceed pre 2008 levels!
  - "Unthinkable" until a few years ago

Why?
- US population is aging – true of all OECD
  - Older people do not drive as often or as much
- Cars are getting more fuel efficient
  - And they can get a lot more efficient still
- Gasoline prices rising
  - Favors more efficient cars, mass transit, shorter commutes, …
Still growing …

US capacity projections through 2040*, GW

* Extrapolating recent growth trends, as is essentially done here, leaves out improvements in energy efficiency, impact of higher prices, and a host of other variables that would affect projections 3 decades into the future

Source: Failure to act: The economic impact of current investment trends in electricity infrastructure, ASCE, 2012
… but at declining growth rate

United States 1950-2010

Source: US Energy Information Administration
Flat as Kansas prairie?
Sectoral energy consumption, Quads/yr

Source: EIA, Annual Energy Outlook 2012, Jan 2012
US Per Capita Elect. Consumption
1990-2011, kWh/PP

Source: Smart Grid Watch, How fast is U.S. electricity consumption growing? April 6 2012
Where have all the kWhrs gone?

Source: AEMO, 2012
More evidence?
"End of demand growth"

- Another example
  - EU’s total energy demand will barely grow by 2030
    - BP says 4% increase in 2010-30
    - Latest predictions from BP, ExxonMobil, others consistent
- Why?
  - EU’s population is not growing much while aging
  - EU’s economy not growing as fast as it used to
  - Advances in energy efficiency > growth in GDP
OECD vs. ROW
Two different worlds

Source: 2012 The Outlook for Energy: A View to 2040, ExxonMobil, Dec 2011
Chindia
It is a different story in developing economies

Source: BP Energy Outlook 2030
High growth regions
Electricity demand growth projections, in trillion kWhrs

2: Influencing demand
Demand drivers
What are the fundamental drivers of growth?

Key variables
- Economic growth derives energy demand
  - But relationship is **not** 1-to-1 **nor** pre-ordained
  - Gradual shift toward electricity
- Population & growth in income significant drivers
  - Number of households, buildings, cars, appliances, etc. matters
  - Per capita consumption & living standards

Policy matters
- Govt. **can** shape/influence demand growth
  - Energy efficiency reduces demand
  - People want “cold beer & hot shower,” not energy per se
Future is **NOT** preordained
Non-OECD growth can be modified

Source:
How can we influence the trends?
Countries follow certain patterns as their economies mature.

Source: BP Energy Outlook 2030
Markets or mandates

"That is the question’

- Mandates?
  - Codes & standards
  - Regulations & incentives
- Markets?
  - Prices ….
  - … and price-induced consumer behavior
The cheapest kWh is the one you don’t use

* Includes current federal & state level incentives, natural gas price is assumed at $4.50/MMBTU
Opportunities abound
McKinsey’s studies
Considerable scope for cost-effective savings

$1.2 trillion US gold mine

Energy efficiency offers a vast, low-cost energy resource for the U.S. economy — but only if the nation can craft a comprehensive and innovative approach to unlock it.

Significant and persistent barriers will need to be addressed at multiple levels to stimulate demand for energy efficiency and manage its delivery across more than 100 million buildings and literally billions of devices.

If executed at scale, a holistic approach would yield gross energy savings worth more than $1.2 trillion, well above the $520 billion needed for upfront investment in efficiency measures (not including program costs).

Such a program is estimated to reduce end-use energy consumption in 2020 by 9.1 quadrillion BTUs, roughly 23 percent of projected demand.

664 TWh EE potential
EPRI claims 14% energy reduction possible by 2030

Source: A. Faruqui, Brattle Group, Aug 2010
Declining sales?
EE potential for TVA

Source:
Codes & standards
Thou shall do as told, or else …
End of demand growth?
Not only feasible but cost-effective

Source: IEE white paper, May 2011
Latest US EE rankings

2011 State Energy Efficiency Scorecard Rankings

Source: American Council for an Energy-Efficient Economy
EE savings as % of retail sales
What do you get for $2.1 B?
CA IOU ratepayer investment in EE, 2006-08
2006-8 CA Highlights

- $2.1 billion investment 2006-08
- 6,000 GWh, equivalent to 3.2% of 2008 sales
- 1,100 MW peak demand
- 4 million tons of CO2 avoided, 760,000 cars removed
- 64 million CFLs (roughly 2 per capita)
- 41 million sq ft insulation
- 1.2 million new EE appliances
- 775 MWH saving in manufacturing
- 550,000 hrs of training for 40,000 attendees
- EE campaign reached 9.5 million households
California keeps it flat
Per capita electricity consumption

Source: A. Faruqui, Brattle Group, Aug 2010
Case for standards
CEC, May 2012

- Starting 2014 avg. new homes 25% more efficient
- Non-residential buildings 30% more efficient
- Mostly through better windows, insulation, ventilation
- Extra cost of avg. new home: $2,290
  - $11/month assuming 30-yr. mortgage
- Save $27/month in lower heating, cooling & lighting costs
- Net $6,200 savings over 30 yrs.
- California to save 14 GWhrs of electricity over 30 yrs
- Eliminating 6 major power plants
PNW does it even better
Index with 1980 = 1
Another way to go: EERS
Impose mandatory targets similar to RPS

State Energy Efficiency Resource Standard (EERS) Activity
November 2010

Twenty-four states have enacted energy savings goals, or Energy Efficiency Resource Standards (EERS), through legislation and several states have a pending EERS.
The options?

- **Structural shift in economy**
  - Away from energy-intensive manufacturing?

- **Appliance standards**
  - Lighting, HVAC, electronics, motors

- **Building codes**
  - Zero Net Energy concept?

- **Prices**
  - Smart prices to smart devices

- **Consumer attitude/behavior**
Regulations & incentives
Fix traditional misalignments
How do we get water to go uphill?

- I know of **NO** private utility that would say, “We’re going to invest billions in customer energy efficiency measures because we believe it is the right thing to do.”

- In nearly all cases, policy makers &/or regulators have had to directly intervene by introducing incentives, rewards, penalties, backed by supportive policies
Change institutional mindset

- For energy efficiency to make business sense
  - Allow full cost recovery
  - Allow recovery of lost revenues
  - Allow a reward or incentive above & beyond the above
- Even today, few states actively promote EE
  - In some cases:
    - Set mandatory targets
    - Penalty & reward
Rates rise but bills fall
Fewer kWhs means higher cents/kWhr
“Decoupling”
Profits decoupled from kWhr sales

Source: NRDC Feb 08
Price signal
AT&T: “Let your fingers do the walking”
Direction of electricity prices?

- Universally up

Why?
- Shift to cleaner/low carbon fuels
  - Coal is facing strong headwinds within OECD
- Shift to more renewables/DG
  - Requires significant subsidies
  - Intermittency requires backup
- Environmental/emission restrictions
  - Example #1: US EPA
  - Example #2: Australia’s carbon tax, CA climate bill
End of economies of scale?
Residential tariffs in NSW & QLD, in nominal Aus$/MWh (left scale) and inflation-adjusted (right scale)

Source: ESAA, Comparing Australian and international electricity prices, at http://www.esaa.com.au/content/detail/internationalAustralianelectricityprices based on study by NUS Consulting Group
When do you use electricity?

Source: PG&E Home Energy Report
How do you compare to your peers?
Last month’s consumption relative to others, in kWhrs

Source: PG&E Home Energy Report
### SCE 5-tier increasing block tariff

Promotes energy efficiency, penalizes heavy users

<table>
<thead>
<tr>
<th>Tier</th>
<th>Price cents/kWh&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Baseline allowance&lt;sup&gt;2&lt;/sup&gt;</th>
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<tr>
<td>Tier 1</td>
<td>11.808</td>
<td>0-100%</td>
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<tr>
<td>Tier 2</td>
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<td>Tier 3</td>
<td>23.334</td>
<td>131-200%</td>
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<td>Tier 4</td>
<td>26.833</td>
<td>201-300%</td>
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<tr>
<td>Tier 5</td>
<td>30.334</td>
<td>&gt;300%</td>
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</table>

* Baseline allowance is determined by applicable climate zone; higher allowances apply to high temperature zones, lower for mild coastal zones

<sup>1</sup>For low-income customers, applicable prices for the first three tiers are 8.533, 10.668 & 18.051 cent/kWh respectively with tier 3 rate applied to all usage above 130% of baseline allowance.


Source: Southern California Edison Company
Sustainable?
Rising tariffs encourage more DG & EE

Source: Ed Cazalet presentation Mar 2012 based on PG&E projections
Distributed generation
California Gov. envisions 12 GW of DG
Getting cheaper
Solar costs declining rapidly

Source: Net energy metering, RMI, Mar 2012
Zero Net Energy
Would it apply to developing countries?

on-side electricity demand

distributed renewable generation

zero net energy
Vanishing bill
For ZNE/DG customers consumption drops but costs remain

Source: Net energy metering, RMI, Mar 2012
From consumer to prosumer
Net energy metering (NEM) gives credit for excess PV generation

Source: Net energy metering, RMI, Mar 2012
Vexing cost allocation problem
As network costs rise new ways are needed to allocate costs

Source: Net energy metering, zero net energy & the distributed energy resource future, Rocky Mountain Institute report prepared for PG&E, Mar 2012
Other schemes to shift demand
Texas peak demand case study
ACEEE study, Mar 2007
Take away points

- End of demand growth is in sight
  - Almost a given within OECD
  - ROW to follow

- Policy matters
  - Can (and should) influence demand
Questions?

- Thank you
Smart Grid
Forthcoming Nov 2011

Integrating Renewable, Distributed, 
& Efficient Energy

Fereidoon P. Sioshansi
California on top

United but highly uneven states of America

<table>
<thead>
<tr>
<th>Rank</th>
<th>State</th>
<th>Electric ($M)</th>
<th>Gas ($M)</th>
<th>Total ($M)</th>
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</table>

U.S. total: 2,603 | 529 | 3,132 |

Low hanging fruit

Source: IEE white paper, May 2011
From static to dynamic pricing
The question is how dynamic?

Source: A. Faruqui, Brattle Group, Aug 2010
California going low-carbon
Don’t count on nuclear, CCS, cap-&-trade, or market signals

Source: Black & Veatch
80% by 2050!
German target post Fukushima

Renewable targets
German renewable targets as % of total electricity generation

Source: German Govt. proposals
* Florida now has a 20% RPS by 2020 not reflected in the map. There may be other states as well that have adopted mandates since the map was published
Source: Edison Electric Institute, 8 Apr 08