

# Investing in the Future

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**...5B people want to live like 500M do today**



“when the train of history hits a curve,  
the intellectuals fall off.”

- Karl Marx

“All progress depends on the  
unreasonable man”

- George Bernard Shaw

“Human salvation lies in the hands of  
the creatively maladjusted”

- Martin Luther King

experts reality check

“Heavier-than-air flying machines are impossible”

- Lord Kelvin, President, Royal Society, 1895

“The telephone has too many shortcomings to be seriously considered as a means of communication.”

- Western Union Internal Memo, 1876


“There is no reason for any individuals to have  
a computer in their home”

- Ken Olsen, President, Chairman and Founder of DEC, 1977



# India: Land of many cell phones, fewer toilets

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 Enlarge

by Rafiq Maqbool, AP

In this Oct. 22, 2010 photo, a boy walks to a latrine outside his makeshift home at a slum in Mumbai, India. When U.S. President Barack Obama visits India Nov. 6, 2010, he will find a country of startlingly uneven development and perplexing disparities, where more people have cell phones than access to a toilet, according to the United Nations. (AP Photo/Rafiq Maqbool)

By Ravi Nessman, The Associated Press

MUMBAI, India — The Mumbai slum of Rafiq Nagar has no clean water for its shacks made of ripped tarp and bamboo. No garbage pickup along the rocky, pocked earth that serves as a road. No power except from haphazard cables strung overhead illegally.

And not a single toilet or latrine for its 10,000 people.

Yet nearly every destitute family in the slum has a cell phone. Some have three.

When President Barack Obama visits India Nov. 6, he will find a country of startlingly uneven development and perplexing disparities, where more people have cell phones than access to a toilet, according to the United Nations.

It is a country buoyed by a vibrant business world of call centers and software developers, but hamstrung by a bloated, corrupt government that has failed to deliver the barest of services.

Its estimated growth rate of 8.5 percent a year is among the

highest in the world, but its roads are crumbling.

It offers cheap, world-class medical care to Western tourists at private hospitals, yet has some of the worst child mortality and maternal death rates outside sub-Saharan Africa.

And while tens of millions have benefited from India's rise, many more remain mired in some of the worst poverty in the world.

Businessman Mukesh Ambani, the world's fourth-richest person, is just finishing off a new \$1 billion skyscraper-house in Mumbai with 27 floors and three helipads, touted as the most expensive home on earth. Yet farmers still live in shacks of mud and cow dung.

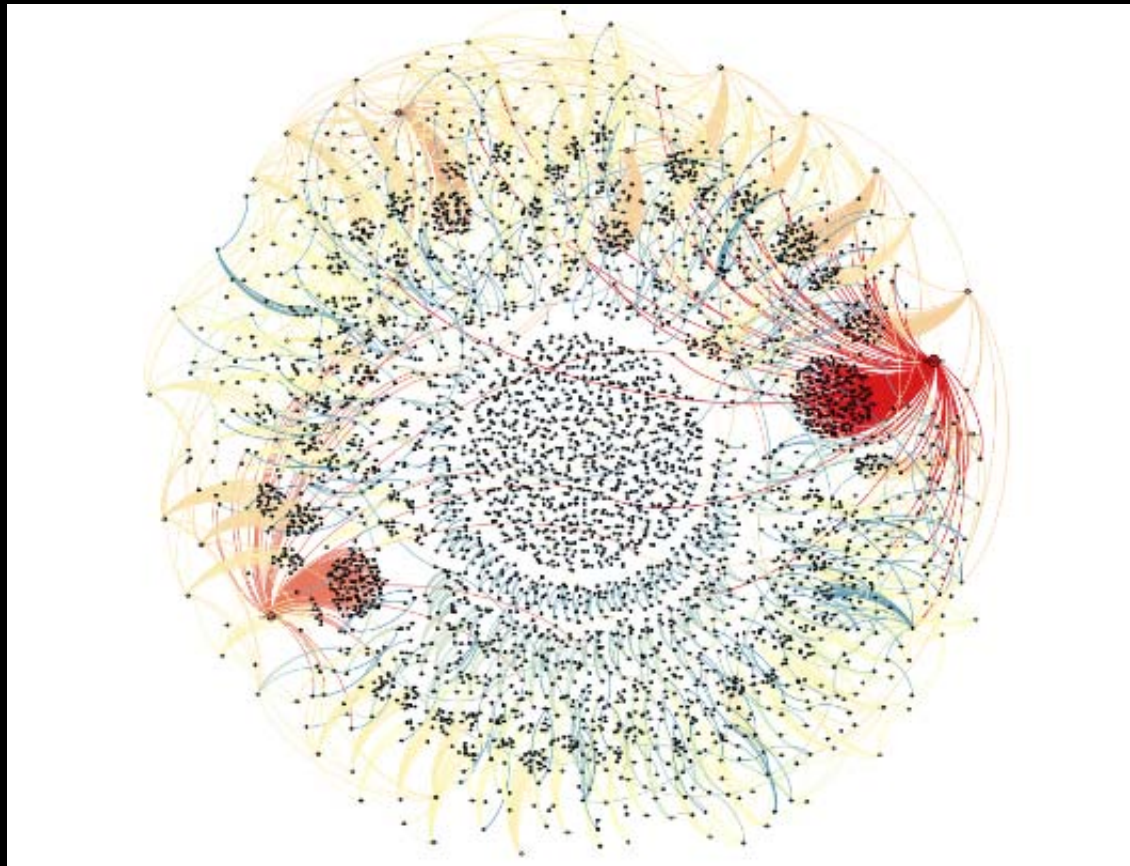
# TWEET?

Did not exist 5 years ago!

Today: More than 100 million users  
65 million tweets are posted each day

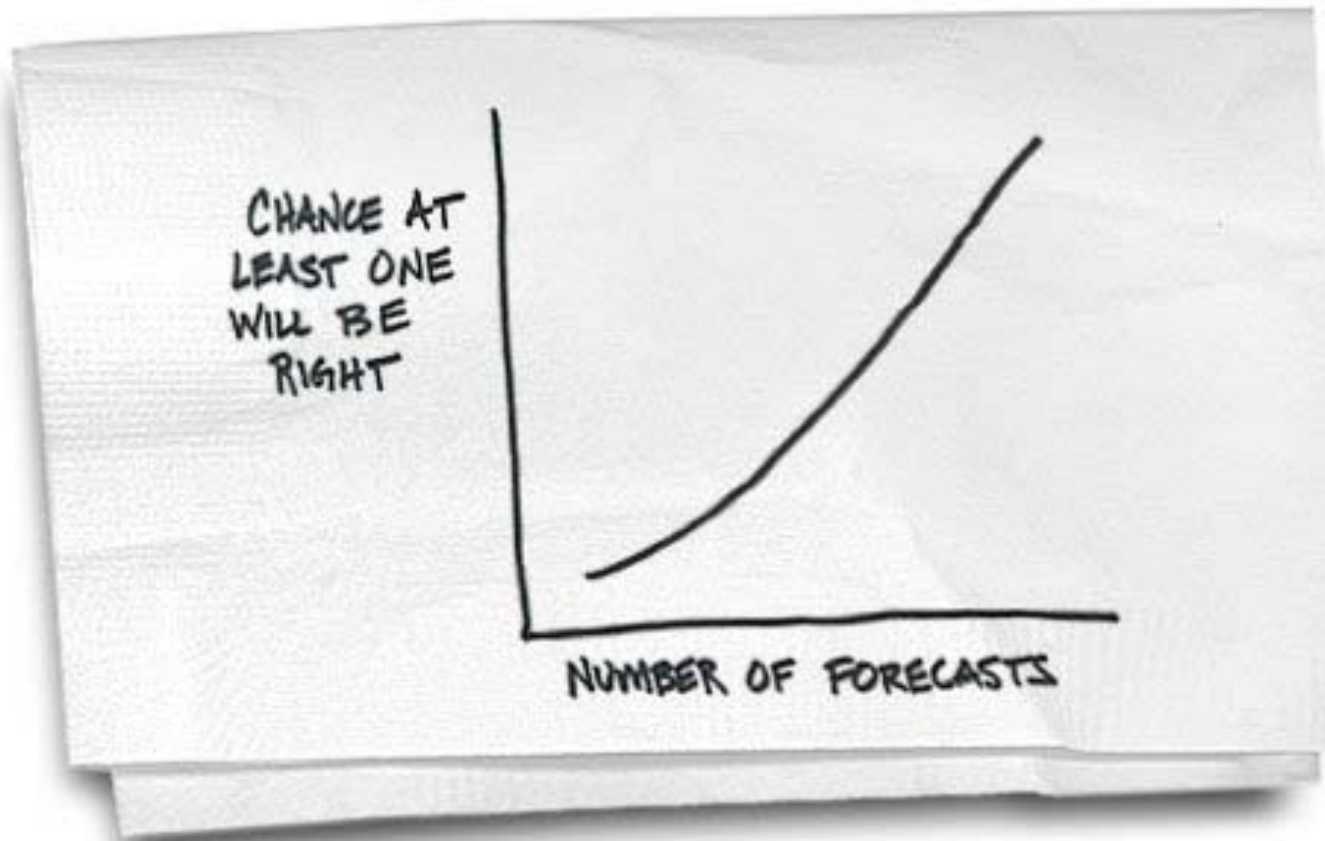
- 140 characters that millions of people follow
- Can tell the mood of a nation

# Egyptian revolution...

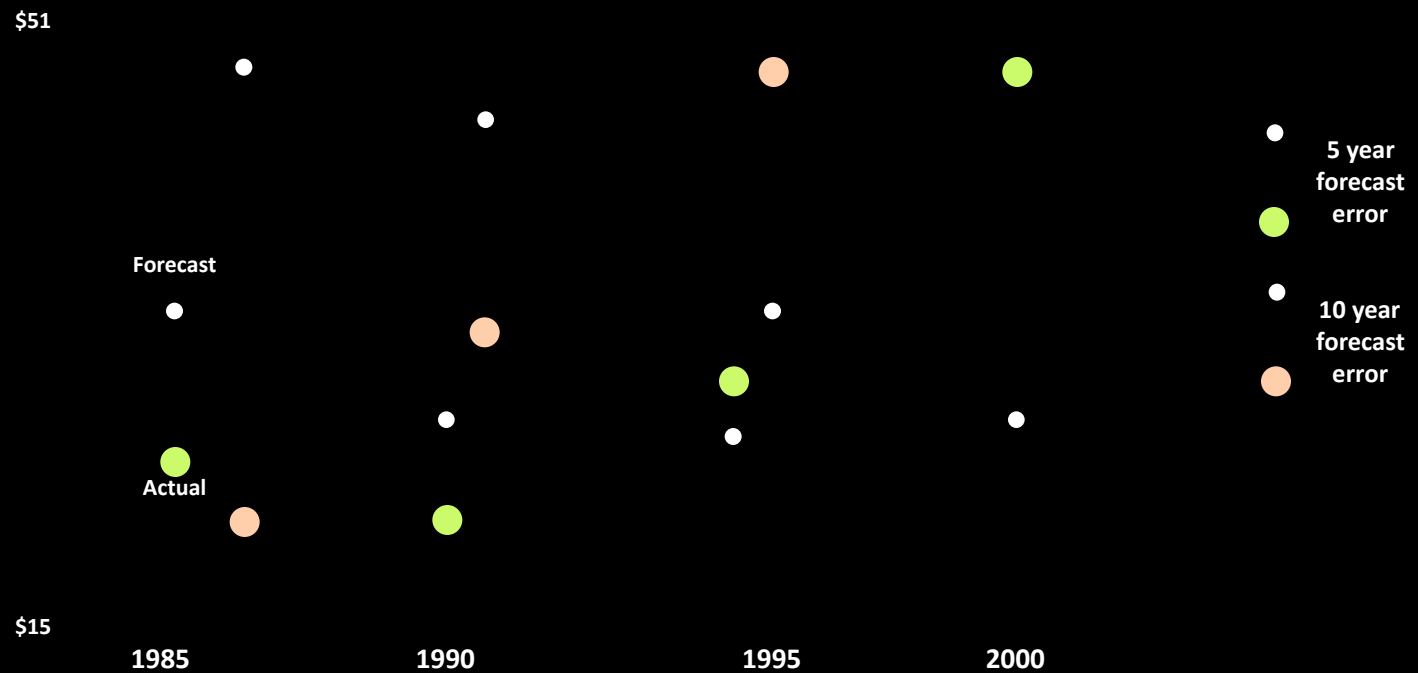


Map of #jan25 tweets and retweets the moment Mubarak resigned

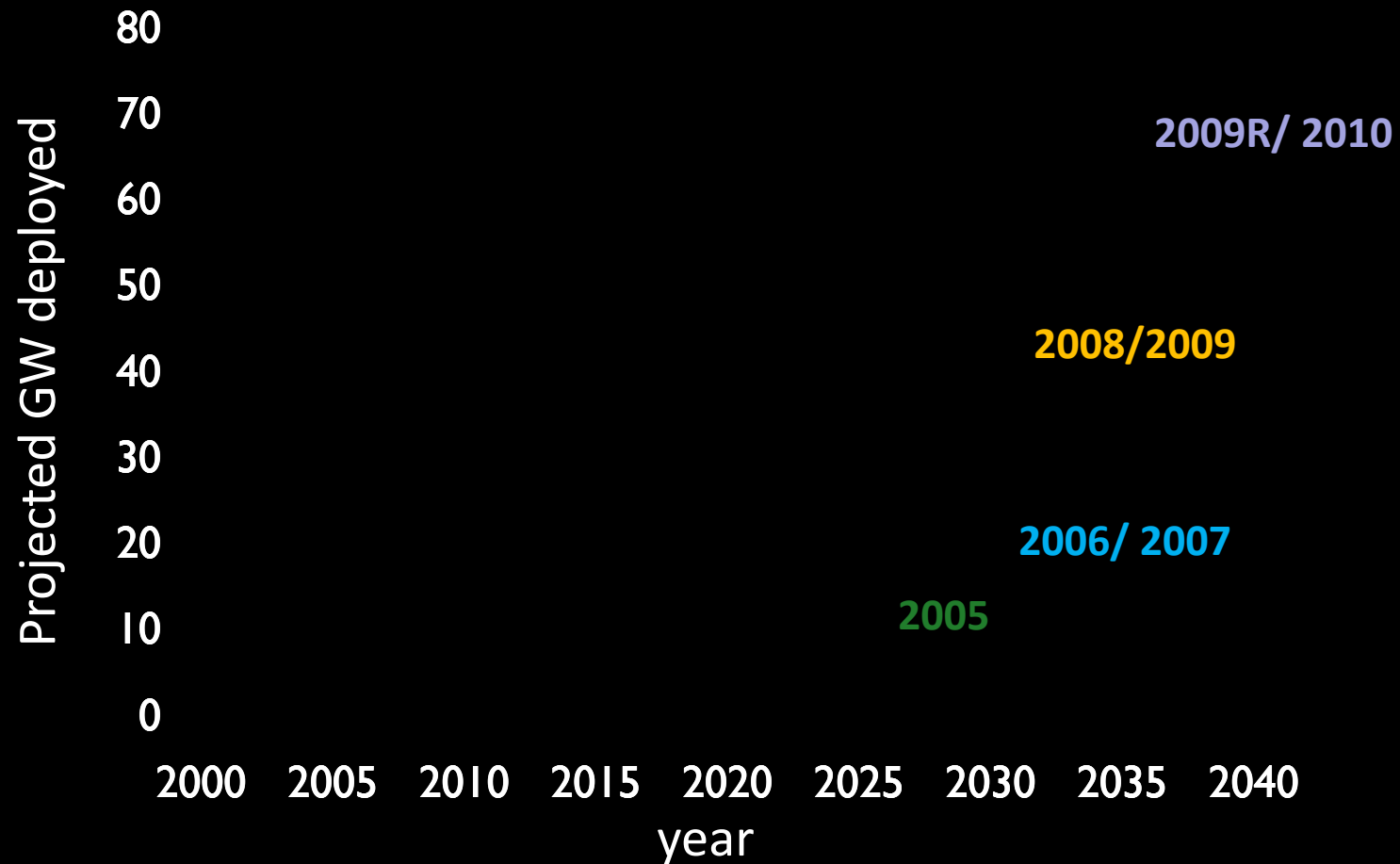
# The reliability of forecasting



# oil price forecasts (1985-2005)



# Changing with the wind: EIA wind forecasts

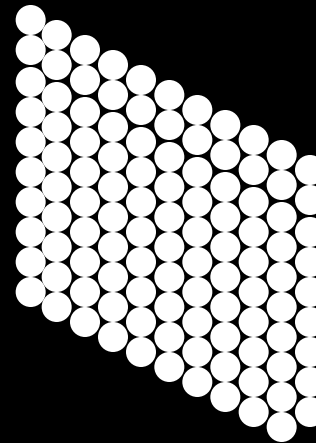


# Mckinsey : US mobile subscribers

1980 forecast for 2000



forecast



actual

# yesterday's technology, tomorrow's forecast

1980's phone:



year 2000 phone:





Could McKinsey or an analyst have  
predicted :

...Twitter?

...India's cellphone to toilet ratio?

...pharma, computer, telecom, media changes

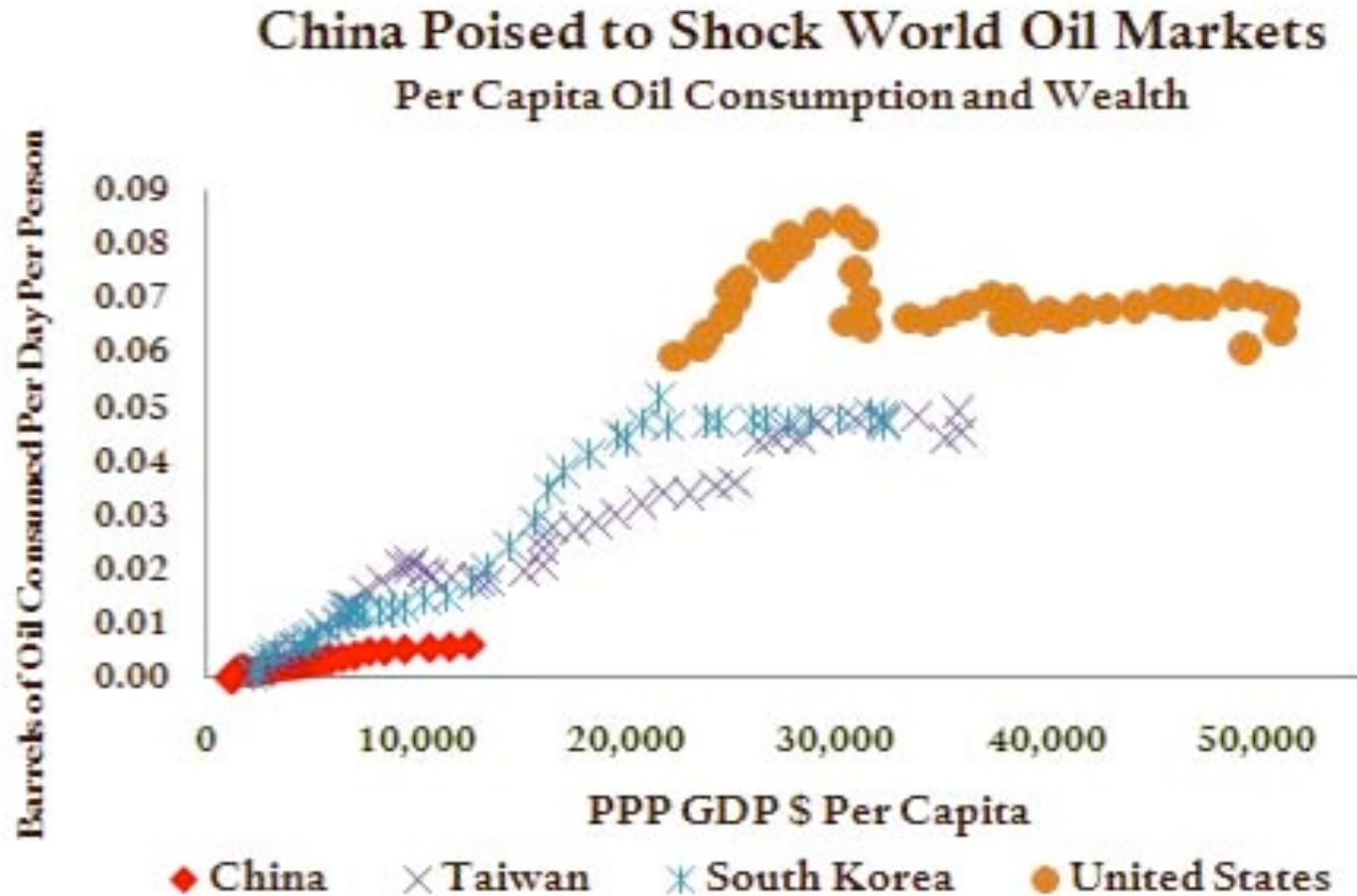
...China's rise, Berlin wall, Egypt, USSR?

# quantitative modeling **flaws**

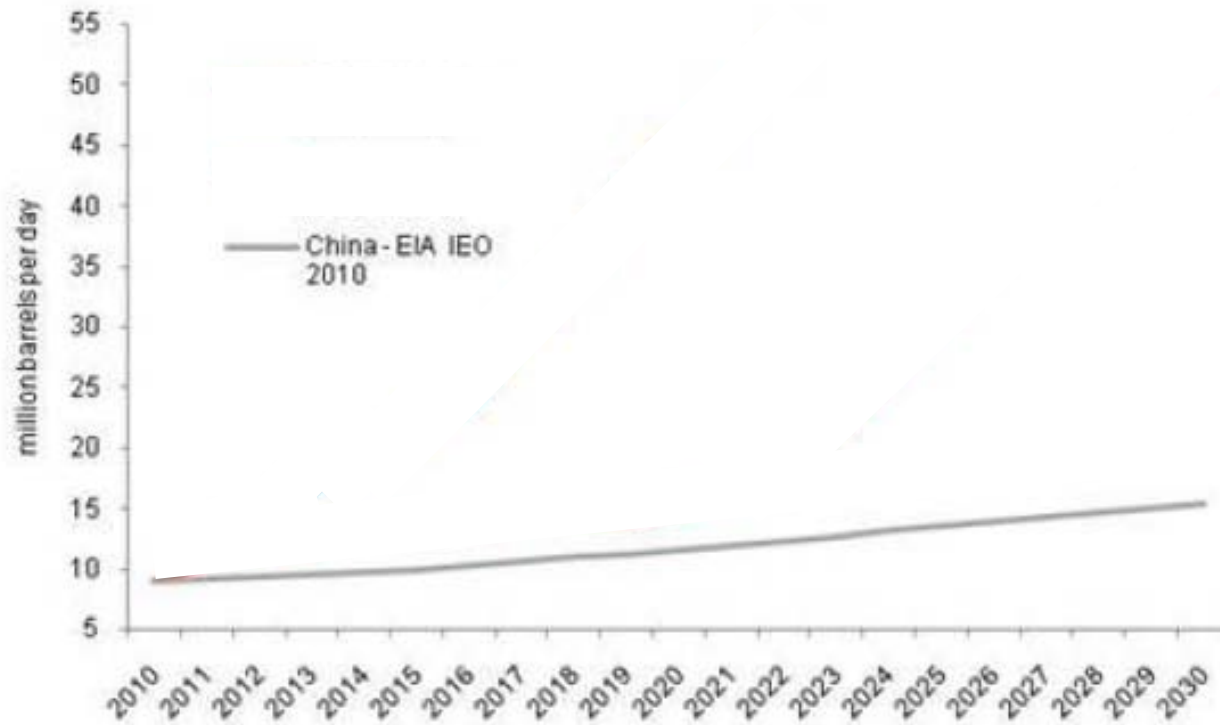
models with given inputs are precise but inaccurate

- chasing “false precision”; chasing 3<sup>rd</sup> order effects
- input the measurable, ignore the immeasurable
- obscured embedded assumptions

**If China's per capita oil use = South Korea, its share of global use goes from 10% to 70%!**



# China's oil demand, EIA vs. ??



# the folly of predictions: tetlock study

**hundreds of experts.**

**80,000+ “expert” forecasts & 20+ years**

**results: experts are poorer forecasters than dart-  
throwing monkeys**

# why?

“.... experts were much tougher in assessing the validity of information that undercut their theory than they were in crediting information that supported it.”

- Tetlock

# ... experts were asked to predict about

- **Soviet Union (in 1988) - by 1992, Communist Party control will**
  - strengthen
  - weaken
  - remain unchanged
  
- **EU Monetary Union (in 1991) - by 1996, the plan for a common currency**
  - abandoned
  - seriously delayed
  - on schedule
  
- **South Africa (In 1989) - by 1994 there will be**
  - more repressive white control
  - continuation of the status quo
  - less repressive minority rule but no serious power-sharing with blacks
  - major movement toward black majority rule
  - formal establishment of black majority rule

**... with unexpected results**

**No relation between experience and accuracy!**

A robust finding – based on thousands of forecasts made by hundreds of experts.



**The illusion of knowing ...**

**VS.**

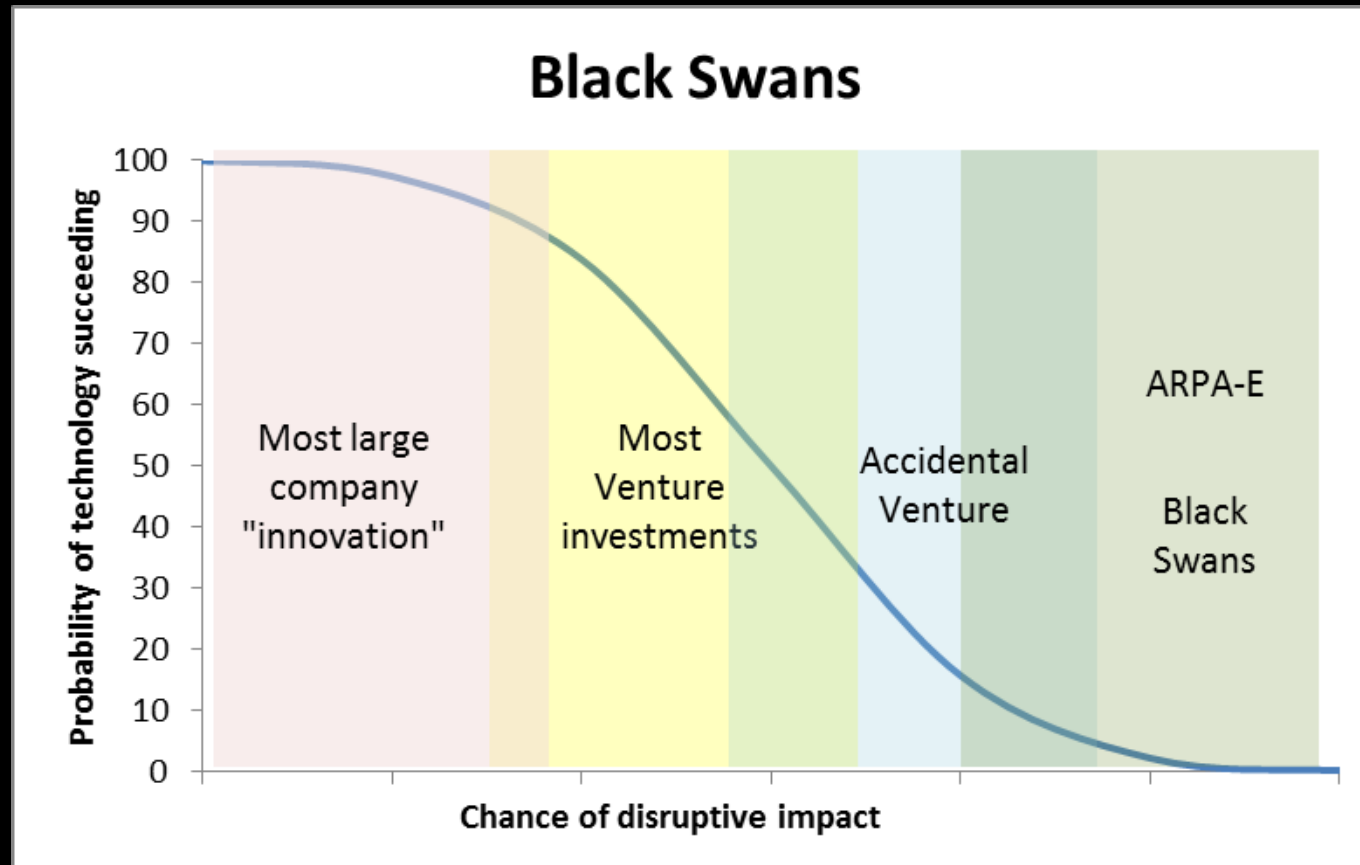
**... knowing that we don't know**

**“extrapolation of the past”**

**VS.**

**“inventing the future”**

# Disruptions are where most will not venture



**Improbable is not unimportant...**

**One risky shot may not make sense...**

**... enough (intelligent) shots can be very profitable**

# “black swan”

...rarity, extreme impact,  
and retrospective  
(though not prospective)  
predictability

***What if oil was a 100% renewable and cheaper than fossil crude oil and we used 50% less of it?***

# kior

“a million year crude production cycle reduced to minutes and  
market competitive?”

# ecomotors

“Engine that delivers 50%+ vehicle efficiency for lower cost?”



***What if coal based electricity could be 75% cleaner and we used 75% less of it for lighting and cooling?***

**ciris**

“ ... clean coal without ever taking it out of the ground”

# calera

“ ... turning problem carbon dioxide into a  
feedstock for building materials”

**soraa**

“no-compromise 80% more efficient pay-for-itself  
lighting”

# caitin

“no new functional thermodynamic cycle for cooling has  
been implemented in decades...  
... but new lower cost HVAC at 80% less electricity”

***What if electricity storage was affordable for both stationary and mobile applications and we had a truly smart grid, well beyond today's "smart meters"?***

# lightsail

“ 5x cheaper grid scale energy storage, using only air”

# Quantumscape/advanced storage

Quantumnanothingamijigit



**What if we applied unconventional technology to large global problems like steel, sugars & agriculture?**

# Advanced Agriculture

“massively cutting fertilizer & pesticide use and increasing yields”

# New metals

“reinvent materials science”

“approach theoretical perfection at large scale”

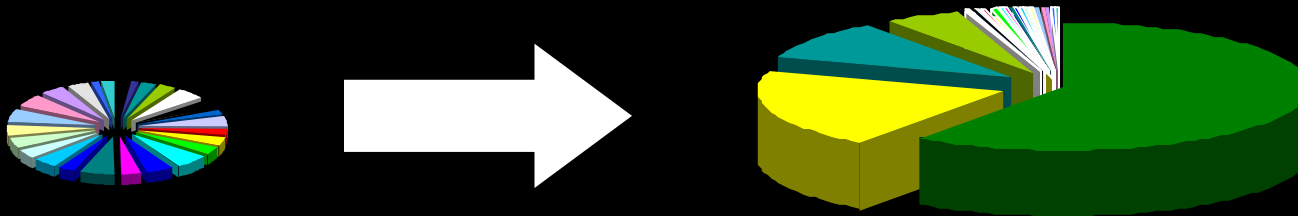
# HCL

“food-grade sugars from any biomass”

# winners take (almost) all =investment viability

5 years out, the group's  
market cap has grown...

Starting Industry Structure



But leaders far exceed the also-rans

# Recommended reading list

“Expert Political Judgment” – Dr. Philip Tetlock

“Predictioneer’s Game” – Bruce Bueno de Mesquita

“How We Decide” – Jonah Lehrer

comments?

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# The New Green: “Maintech not Cleantech”

... oil

... coal

... materials

... efficiency

Reinvent the infrastructure of society

...imagine the possible

# resource multipliers

computational design of materials

nanostructured materials

synthetic biology

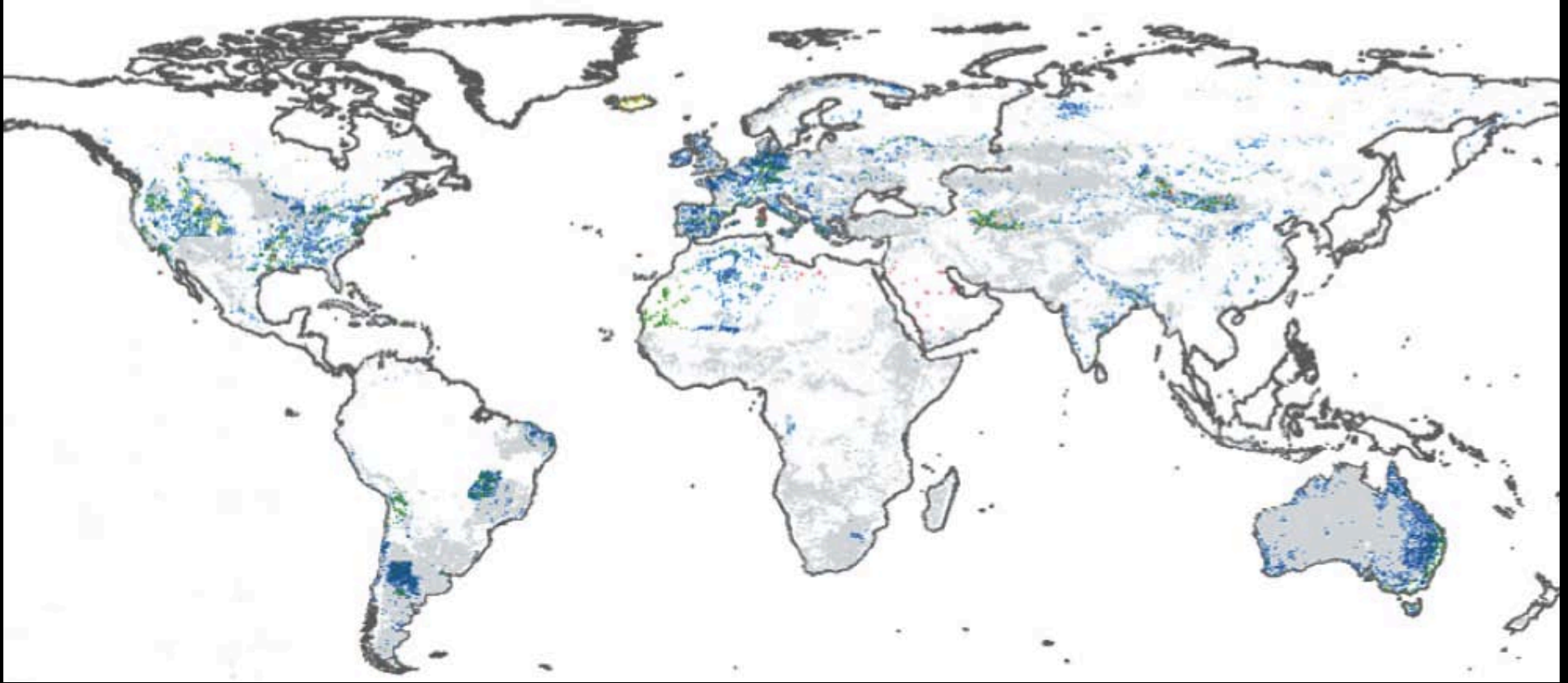
non-chemistry batteries

resonance: Microwave catalysis, depolymerization

better agronomy

.....

# one billion acres...



Area - % former agriculture land abandoned

1 – 20%

20 – 40%

40 – 60%

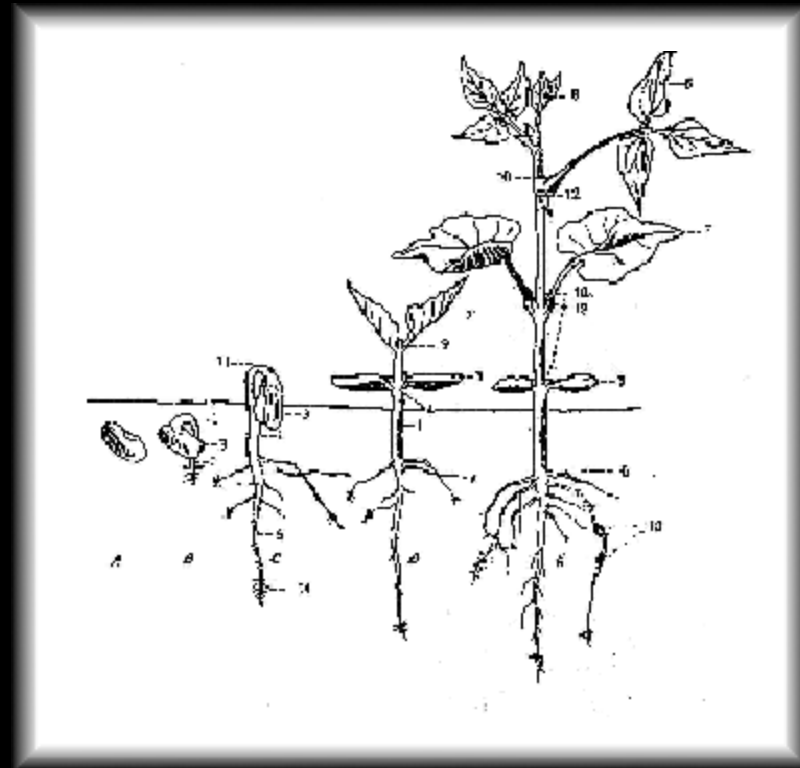
60 – 80%

80 – 100%

# the perennial advantage



# an underground revolution



...engineering roots to maximize local ecosystems?

The 2<sup>nd</sup> green revolution!

# Supercrops: fixing photosynthesis?

Less chlorophyll? → yields +30%

Better rubisco for CO<sub>2</sub> uptake? → yields +??%

Convert C<sub>3</sub> plants to C<sub>4</sub> → yields +25%

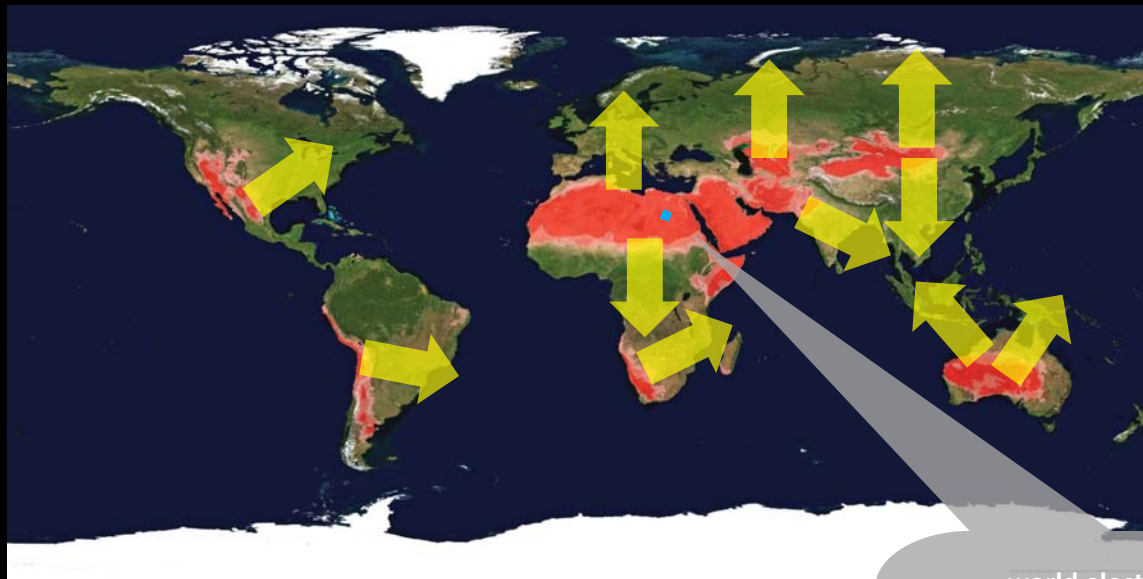


.... Black plants?

# another billion acres?

deserts as solar farms

→ 3000 km



world electricity demand  
(18,000 TWh/y)

can be produced from  
300 x 300 km<sup>2</sup>

=0.23% of all deserts

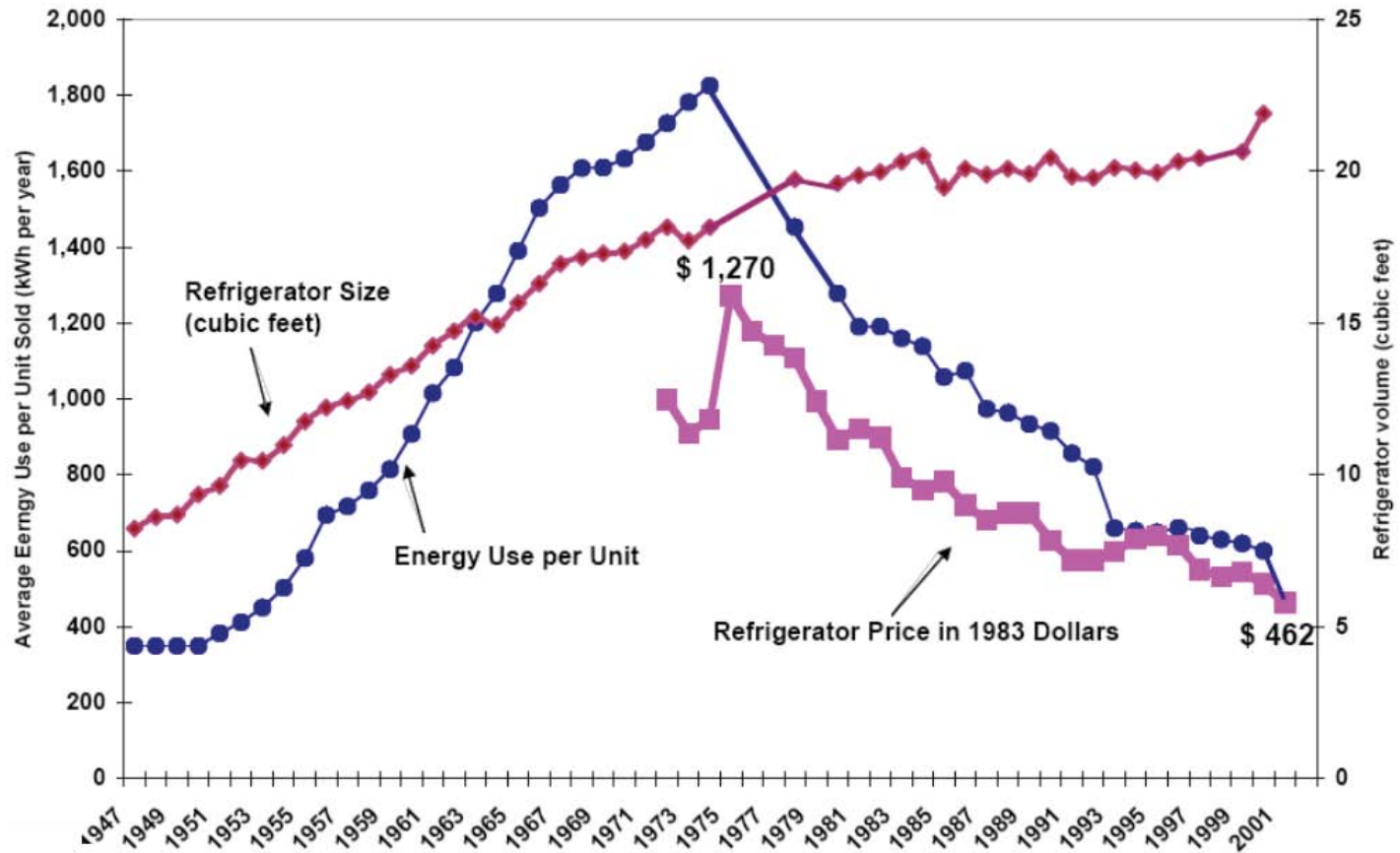
distributed over "10 000" sites



**yet another billion acres...**

Geothermal?

# ... the “Rosenfeld” effect



**refrigerator costs AND energy use continued to decline!**

# as surely as...

1985: **NOT** a PC in every home

1995: **NOT** the internet

2000: **NO** pervasive mobile

2004: **NO** facebook

2007: **NO** iPhone

2010+: reason for optimism

expect change