AGENDA

1. Clean energy investment update

2. Four energy realities

3. New Energy ROI
GLOBAL TOTAL NEW INVESTMENT IN CLEAN ENERGY, 2004-2012 ($BN)

Note: Includes corporate and government R&D, and small distributed capacity. Adjusted for re-invested equity. Does not include proceeds from acquisition transactions.

Source: Bloomberg New Energy Finance
GLOBAL RENEWABLE CAPACITY ADDITIONS (GW)

- Other renewables
- Biomass & Waste
- Wind
- Solar

Note: “Other renewables” includes marine and geothermal power only. Source: Bloomberg New Energy Finance
CLEAN VS FOSSIL-BASED GENERATING CAPACITY INVESTMENT, 2006–12 ($BN)

Note: Clean energy total excludes large hydro. Fossil fuel is investment on coal and gas capacity. We assume capacity retirement of 3.3%/yr for coal and 4%/yr for gas.

Source: Bloomberg New Energy Finance
EQUIPMENT SUPPLY AND DEMAND, 2006-2015 (GW)

SOLAR

- Manufacturing capacity
- Demand

WIND

- Manufacturing capacity
- Demand

Source: Bloomberg New Energy Finance

Note: Supply scenarios based on continued 2012 utilisation rates.
NEX CLEAN ENERGY INDEX 2003 – 2013 YTD

Note: Values as of 10 April 2013; NASDAQ and S&P 500 rebased to 100 on 01 Jan 2003

Source: Bloomberg New Energy Finance
NEW INVESTMENT IN CLEAN ENERGY BY REGION, 2004-2012 ($BN)

North America & Caribbean

Central & South America

Europe

Middle East & Africa

Asia & Oceania

Note: Excludes corporate and government R&D

Source: Bloomberg New Energy Finance
US 2012 – THE CLEAN ENERGY ELECTION

Solyndra! Solyndra! Solyndra!

I’m going to renew the wind Production Tax Credit!

Pictures: Bloomberg
US ANNUAL CLEAN ENERGY INVESTMENT AND CAPACITY ADDITIONS, 2004-2012

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Investment, $BN</th>
<th>Capacity, GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>10.6</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>17.1</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>32.1</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>43.3</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>42.9</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>42.5</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>65.2</td>
<td>-32%</td>
</tr>
<tr>
<td>2011</td>
<td>44.2</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>42.5</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>65.2</td>
<td>-32%</td>
</tr>
<tr>
<td>2015</td>
<td>44.2</td>
<td></td>
</tr>
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<td>2016</td>
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<td></td>
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<td>-32%</td>
</tr>
<tr>
<td>2019</td>
<td>44.2</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>42.5</td>
<td></td>
</tr>
<tr>
<td>2022</td>
<td>65.2</td>
<td>-32%</td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance

- **Other renewables**: +100%
- **Biomass & waste**:
- **Solar**:
- **Wind**:
HENRY HUB GAS PRICE
($/MMBTU)

Source: Bloomberg Terminal
EUROPEAN CREDIT DEFAULT SWAP SPREADS, 2009-12

Source: Bloomberg Terminal
EUROPE - POLICY UNCERTAINTY

Source: Bloomberg New Energy Finance

- Retroactive changes
- Unplanned reduction
TOP 15 COUNTRIES FOR NEW INVESTMENT IN CLEAN ENERGY IN 2012 AND % CHANGE ON 2011 ($BN)

<table>
<thead>
<tr>
<th>Country</th>
<th>2012 Investment ($BN)</th>
<th>% Change on 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>65.13</td>
<td>20%</td>
</tr>
<tr>
<td>United States</td>
<td>35.58</td>
<td>-37%</td>
</tr>
<tr>
<td>Germany</td>
<td>22.80</td>
<td>-27%</td>
</tr>
<tr>
<td>Japan</td>
<td>16.28</td>
<td>75%</td>
</tr>
<tr>
<td>Italy</td>
<td>14.71</td>
<td>-51%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8.34</td>
<td>-17%</td>
</tr>
<tr>
<td>India</td>
<td>6.85</td>
<td>-45%</td>
</tr>
<tr>
<td>Australia</td>
<td>6.19</td>
<td>40%</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.46</td>
<td>20563%</td>
</tr>
<tr>
<td>Brazil</td>
<td>5.34</td>
<td>-32%</td>
</tr>
<tr>
<td>Canada</td>
<td>4.41</td>
<td>-23%</td>
</tr>
<tr>
<td>France</td>
<td>4.31</td>
<td>-34%</td>
</tr>
<tr>
<td>Belgium</td>
<td>4.05</td>
<td>11%</td>
</tr>
<tr>
<td>Greece</td>
<td>3.42</td>
<td>179%</td>
</tr>
<tr>
<td>Spain</td>
<td>2.95</td>
<td>-68%</td>
</tr>
</tbody>
</table>

Note: Excludes corporate and government R&D

Source: Bloomberg New Energy Finance
SUPPLY CHAIN CONSOLIDATION
NEW ENERGY REALITIES

1. Unconventional oil and gas
2. Improving energy intensity
3. Cheap clean energy
4. Unpredictability
US PROJECTED NET IMPORTS OF NATURAL GAS, 2008-20
TRILLION CUBIC FEET

Source: US EIA Annual Energy Outlook, 2010-2013; Bloomberg New Energy Finance

Note: 2013 figures show Early Release
US PROJECTED NET IMPORTS OF NATURAL GAS, 2008-20
TRILLION CUBIC FEET

Source: US EIA Annual Energy Outlook, 2010-2013; Bloomberg New Energy Finance

Note: 2013 figures show Early Release
US PROJECTED NET IMPORTS OF NATURAL GAS, 2008-20
TRILLION CUBIC FEET

Historical

Source: US EIA Annual Energy Outlook, 2010-2013; Bloomberg New Energy Finance

Note: 2013 figures show Early Release
US PROJECTED NET IMPORTS OF NATURAL GAS, 2008-20
TRILLION CUBIC FEET

Source: US EIA Annual Energy Outlook, 2010-2013; Bloomberg New Energy Finance

Note: 2013 figures show Early Release
MAJOR GLOBAL SHALE FIELDS

Source: EIA Assessment of World Shale Gas Resources, April 2011

Note: Technically recoverable shale gas resources shown

200 trillion cubic feet

Canada, Norway, Poland, China, Australia, USA, Mexico, Brazil, Algeria, Libya, South Africa, Argentina

Source: EIA Assessment of World Shale Gas Resources, April 2011
UK SHALE GAS

“The extraordinary windfall, which is completely God-given, that this country has got is shale gas.”

Owen Paterson
UK Environment Secretary

Picture: Getty Images
AUSTRALIA NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 2005–2022

AUSTRALIA NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 2005–2022

TWh

AUD trillion

AUSTRALIA NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 2005–2022

AUSTRALIA NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 2005–2022

AUSTRALIA NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 2005–2022

US NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 1990–2035

Source: EIA, Bloomberg New Energy Finance

Historical

GDP

Feb 2005

USD trn

TWh

US NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 1990–2035

TWh

- Historical
- GDP

USD trn

Source: EIA, Bloomberg New Energy Finance
US NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 1990–2035

TWh

USD trn


Historical

GDP

Source: EIA, Bloomberg New Energy Finance
US NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 1990–2035

TWh

USD trn

Source: EIA, Bloomberg New Energy Finance

Historical

GDP

Dec 2009
Apr 2011

Feb 2005
Feb 2007
US NATIONAL ELECTRICITY MARKET ACTUAL VS FORECAST ELECTRICITY DEMAND, 1990–2035

TWh

USD trn

Source: EIA, Bloomberg New Energy Finance

Historical

GDP

Feb 2005  Feb 2007
US CAR USE AND FUEL EFFICIENCY

**Total vehicle miles travelled (tm/year)**

- 0.5% CAGR since 2007

**Fuel efficiency of new cars (mpg, sales weighted average)**

+3.7% CAGR since 2007

Source: US Department of Transportation Federal Highway Administration; University of Michigan Transportation Research Institute; Bloomberg New Energy Finance

Note: Total vehicle miles grew at 2.7% CAGR between 1971 and 2007
NET OIL AND GAS IMPORT DEPENDENCY, 2010 - 2035
(% of consumption)

Source: IEA

United States

China

European Union

India

Japan

Oil

Gas

2010

2035

Source: IEA
PV EXPERIENCE CURVE, 1976-2012
2012 ($/W)

PV MODULE PRICES HAVE FALLEN 80% SINCE 2008
20% IN 2012

Source: Paul Maycock, Bloomberg New Energy Finance

Note: Prices inflation indexed to US PPI.
AVERAGE LEVELISED COST OF ONSHORE WIND, 1984-2012 (€/MWH)

WIND TURBINE PRICES HAVE FALLEN 29% SINCE 2008

Note: Learning curve (blue line) is least square regression: $R^2 = 0.88$ and 14% learning rate.

Source: Bloomberg New Energy Finance, ExTool
LITHIUM-ION BATTERY EXPERIENCE CURVE

EV BATTERY PRICES HAVE FALLEN 37% SINCE H1 2011

Cost-competitiveness (on total ownership basis)

Battery cost ($/kWh)

Cumulative production capacity (MWh)

Source: Battery University, MIIT, IIT, Bloomberg New Energy Finance

EV Li-ion battery cost forecast (BNEF)

Consumer Li-ion battery experience curve

EV Li-ion battery prices, historical

Consumer Li-ion battery prices, historical

H1 2012 - $689/kWh
H2 2012 - $638/kWh
Clean energy asset investment will be $630bn in 2030 – 73% of total

Source: Bloomberg New Energy Finance

Note:
1. All $bn figures are nominal assuming a 2% annual rate of inflation
2. EfW is energy from waste. Small-scale PV includes commercial and residential scale rooftop PV.
TOTAL PRIMARY ENERGY DEMAND

Source: Bloomberg New Energy Finance
If we look at things like renewable wind, solar, biofuels, we have those sources over the next 30 years growing 700 to 800 percent. But in the year 2040, they’ll supply just 1 percent.”

Rex Tillerson
CEO, ExxonMobil
March 2013
The world of energy is facing a period of unprecedented uncertainty

Fatih Birol
Chief Economist, IEA

Picture: Mikhail Evstafiev, Wikimedia
NEW ENERGY ROI – RESILIENCE

Don’t ask:
“What is the expected outcome?”

Ask:
“What is the worst that can happen?”

Source: Bloomberg New Energy Finance
"TRADITIONAL" THREATS

ACCIDENTS

NATURAL DISASTERS

GEOPOLITICS

SECURITY
NEW THREATS – CYBERSECURITY
CHINA THERMAL POWER GENERATION VERSUS WATER SCARCITY BY PROVINCE, 2010

Freshwater scarcity rating:
- Water deficit
- Severe scarcity
- Moderate scarcity
- No scarcity

100TWh
CHINA THERMAL POWER GENERATION VERSUS WATER SCARCITY BY PROVINCE, 2030

Freshwater scarcity rating:
- Water deficit
- Severe scarcity
- Moderate scarcity
- No scarcity

100TWh
MAJOR GLOBAL SHALE FIELDS

Source: EIA Assessment of World Shale Gas Resources, April 2011

Note: Technically recoverable shale gas resources shown
MAJOR GLOBAL SHALE FIELDS – WATER STRESS

Canada
Mexico
USA
Brazil
Argentina
South Africa
Norway
Poland
Algeria
Libya
China
Australia

Note: Technically recoverable shale gas resources shown

Source: Shale gas resources: EIA Assessment of World Shale Gas Resources, April 2011; Water Stress: UNEP, Bloomberg New Energy Finance
SOCIAL ACCEPTABILITY – FRACKING, TAR SANDS

Source: Wikimedia commons
CLIMATE CHANGE
NEW ENERGY ROI – OPTIONALITY

In times of volatility...

...options have extraordinary value

Source: Bloomberg New Energy Finance
### OPTIONALITY – SO WHERE ARE THESE OPTIONS?

<table>
<thead>
<tr>
<th>TECHNOLOGY OPTIONS</th>
<th>OPERATIONAL OPTIONS</th>
<th>FINANCIAL OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>Natural hedges</td>
<td>Capital light</td>
</tr>
<tr>
<td>Power storage</td>
<td>Dual sourcing</td>
<td>Low leverage</td>
</tr>
<tr>
<td>Demand management</td>
<td>Market diversification</td>
<td>Structured finance</td>
</tr>
<tr>
<td>Interconnection</td>
<td>Sector diversification</td>
<td>Conditional commitments</td>
</tr>
<tr>
<td>Fuel flexibility</td>
<td>Value chain diversification</td>
<td>Hedging</td>
</tr>
<tr>
<td>Mini-grids</td>
<td>R&amp;D</td>
<td>Guarantees</td>
</tr>
<tr>
<td>CCS readiness</td>
<td>Coalitions</td>
<td>Option pricing</td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance
OPTIONALITY – INVESTOR EXAMPLE

$48 billion

$1.5 billion
A tsunami of information – Are you surfing or drowning?

Source: Bloomberg New Energy Finance
INTELLIGENCE

**MACHINE INTELLIGENCE**
- Smart grid
- Internet of things
- Pervasive sensors
- Automated optimisation
- Big data

**HUMAN INTELLIGENCE**
- Consumer behaviour
- Market intelligence
- Talent management
NEW ENERGY ROI

DINOSAUR HEURISTICS

- Scale
- Centralisation
- Baseload-plus-peak
- Dispatch management
- Vertical integration
- Confidentiality
- Defence budget

MAMMAL HEURISTICS

- Efficiency
- Network
- Responsiveness
- Demand management
- Coalitions
- Data sharing
- R&D budget

Photos: Wikimedia Commons
THANK YOU!

RESILIENCE

OPTIONALITY

INTELLIGENCE