Global Energy Trends; 2030 to 2050

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This note synthesises and analyses the key conclusions from seven recent, authoritative studies that have given projections of future global energy trends through a period to, and beyond, 2030.

The six studies examined are as follows:

   Hart Energy, March 2011

The key points/takeaways from all seven reports are summarised on the attached spreadsheet covering the energy mix, supply and demand, global population, non-OECD growth in affluence and global economic performance.

Predicting future energy trends are always fraught with uncertainties. None of the projections can ever be expected to give a clear, unambiguous pathway to confidently predict future energy trends. It should be noted that none of these reports envisage a “business as usual” future, all recognising the real challenges and stresses that will be encountered over the next 20+ years.
There are several important uncertainties that should be addressed with regard to charting the future course of energy trends:-

- Rate of global GDP growth. Reference growth cases range between 2-3%/year
- Rate of global population growth. A United Nations survey\(^1\) gives a range of between 7.8-9 billion by 2030
- Rate of increasing affluence in the Non-OECD countries. BP’s report sees the collective non-OECD GDP on a purchase price parity (PPP) basis as overtaking OECD performance in this decade.
- Political issues that include wars, protectionism, resource nationalism, lack of resolve on climate change issues.
- Volatile and rising commodity prices for all energy sources
- Rate of uptake of the renewable, non-carbon alternatives
- Rate of technological innovations to enable switching away from fossil fuels

Three of the reports, IEA, EIA and Shell, apply sensitivities and cases that lay out possibilities under varying scenarios. The IEA-WEO report places emphasis on the degree of compliance and implementation with climate change initiatives. In its most climate compliant case global agreement is reached on limiting atmospheric concentrations of carbon dioxide to below 450ppm with consequent significant reductions in fossil fuel usage.

Interestingly, Shell lays out two possible scenarios; (1) a “Scramble” for energy with nations competing for limited, declining, unsustainable fossil resources, (2) a consensual scenario called “Blueprint” in which major economies seek common solutions. However, Shell qualifies its finding; in its own words, “there are no ideal answers” (TANIA).

Both BP and ExxonMobil present their findings based on single “best estimate” assumptions, in BP’s own words; “to the best of our knowledge”. Exxon Mobil’s study is entitled “A view to 2030”.

IBM takes a management and business-oriented approach to its forecasts. During 2010 IBM interviewed 100 corporate level executive across a wide spectrum that included people from the oil & gas, chemical, power generation industries, government agencies and expert analysts.

\(^1\) United Nations World Population Prospects, 2004 Revision, Vol. III

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The key conclusions from all six reports:-

**Global Population**
- 7.8-9.0 billion in 2030, representing a 10-31% growth over current figures
- 7 billion in 2011

**Investment Requirements**
- $38 trillion needs to be invested in energy until 2035. This will require an average annual spend of $1-1.2 trillion of which 40-50% will be in oil and gas projects.
- 66% in non-OECD countries
- $17 trillion required in electricity generation and transmission

**Global Economic Performance**
- Reference global GDP growth; 3.2%/year
  - 4.4%/year growth in Non-OECD
  - 2.0%/year growth in OECD (EIA and EXM figures)

**Global Growth in Affluence**
- GDP (PPP basis) OECD/Non-OECD equalises between 2015-2020
- By 2030 non-OECD economies outperform OECD economies by 25%

**Overall Global Energy Demand (all sources)**
- By 2030/2035 35-50% greater than present

**Crude Oil**
- The ‘easy oil’ has either gone or is declining rapidly
- Crude oil remains as leading primary energy resource until at least 2030
- OPEC increases its global supply share from the current 33% to 46%
- Non-OECD crude oil demand overtakes OECD demand in this decade. By 2030 the ratio for global demand will be 60/40 in favour of the non-OECD.
- Tight supply will lead to high commodity prices.

**Reference prices in 2035 (2010 dollar prices)**
- IEA $113/bbl
- EIA $135/bbl, high Price $210/bbl, low price $51/bbl
Demand from China will double from 8mb/d currently to 17.5 mb/d by 2030

Global oil production/supply range 99 mb/d (IEA)-110 mb/d (EIA) in 2030

Global oil production peaks between 2015 and 2025

OECD crude oil demand peaked in 2005 and continues to decline

Natural Gas

Natural gas is favoured for power generation. Per unit of mass it emits less than 50% carbon dioxide than coal. It is also seen by many as a transition fuel that will bridge the period to when fossil fuels will be superseded by renewables

Transition Fuel? Many energy analysts label natural gas as a 'bridging' fuel to non-carbon green sources. However, Shell and others consider that natural gas will be a key energy source for many decades. Natural gas will certainly replace/supplant coal, oil and nuclear in many markets.

Strong demand. It will be the fastest-growing fossil fuel with 1.3+%/year-on-year growth. ExxonMobil forecasts a 60% growth in gas demand by 2040

Gas-to–power market will grow by 2.5%/year

2035 Gas price forecasts ($2010) $12/mmBtu Europe

$9mmBtu U.S. and Canada

$14mmBtu Pacific Rim

Power Generation

Electricity demand 80% higher in 2040 as compared with 2010

Energy for power generation will reach 40-50% of overall energy demand by 2035-2040

Electricity demand 80% higher in 2040 as compared with 2010

Global power generation nearly doubles with installed capacity rising to ~35TW\(^2\) by 2030. Global installed capacity in 2006 was 16TW.

Coal

Coal use declines in OECD because of climate change policies & legislation.

During 2010’s decade coal use will continue to increase in non-OECD economies led by China where coal will account for 75%+ used in power generation

However, coal demand is expected to decline from 2020 onwards

\(^2\) TW = The terawatt, equal to one trillion \((10^{12})\) watts
Nuclear
- The third-largest energy source used in power generation, after coal and natural gas
- Largest non-carbon source of energy for power generation
- Will account for between 5-13% of the global energy mix, and dependent on environmental acceptance
- 2% annual growth is forecast despite the 'Fukushima effect' on the future of nuclear energy

Renewables
- Wind, wave, tidal, solar, biomass will still only account for only 4% of the overall global energy mix by 2030 despite the aspirations of many politicians and legislators
- IEA’s estimate of investment needs for renewable energy for electricity $17trillion by 2035 (2011dollars)
- Wind is the fastest-growing energy source at 8%/yr
- Alternatives/ renewables are limited by viability, scalability, suitability and low returns on investment as compared to fossil fuels (IBM)

Transportation
- 90% of transportation will be petroleum-fuel based in 2040 (down only 5% from 2011)
- Hybrid vehicles will comprise 50% of the road fleet by 2040 (up from 1% in 2010)
- Road vehicle fleet to double from 800 million to 1.6 billion vehicles by 2040

Carbon Policies, Legislation and Trading
- In IBM’s study two-thirds of respondents did not believe that global accords would be reached to curb carbon emissions from fossil fuels.
- Globally disparate carbon regulations
- CO2 concentrations to finally level off in 2030s as legislation starts to take effect (ExxonMobil)
- IEA’s 2011 WEO report places strong emphasis two scenarios:-
  - “New Policies” where governments agree to reduce fossil fuel consumption through greenhouse gas emissions, and the phasing-out of fossil fuel subsidies
“450ppm” Scenario where global agreement is reached to reduce carbon emissions to below an atmospheric concentration ceiling of 450ppm CO$_2$ by 2030. This CO$_2$ level is assumed to be consistent with limiting global temperature rise to less than 2°C.

The future of International and National Oil Companies (IOCs & NOCs)

- IOCs are challenged to replace and grow petroleum reserves and production
  
  Trends for IOCs
  
  - Diversify into other energy sources and services (nuclear, power generation, non-conventionals, alternatives/renewables)
  - Form Joint-Venture alliances with NOCs in which IOCs provide expertise, market access
  - Enter into pure service contracts (example: Iraq 2009)

- IOCs surviving into 2030s rely on 5 attributes:
  
  - Performance management
  - Enterprise risk management
  - People management
  - Operational excellence
  - Adaptive business models (IBM)

- NOCs become more aggressive in international ventures. So-called INOCs (internationally-focused national oil companies—examples CNPC, ONGC, Petronas) compete more with IOCs for new opportunities

Government Involvements

- Tighter controls on oil and gas operations and higher levels of regulation are anticipated that might impede the rate of development of new oil and gas projects.
- Governments foster alternatives to fossil fuels-renewables, hydrogen, fuel cells and nuclear
Geopolitics and Competition

- China will be the leading economic power by 2030 and will continue to pursue, “an aggressive international energy security agenda” (IBM)

Technical Developments/Breakthroughs

- Continuing engine developments with improved efficient combustion\(^3\), electric vehicles, 'plug-in' hybrids. Fuel cells in transportation finally come of age in 2020s with introduction mass market fuel cell hybrid vehicles (FCHVs)

- Significant global developments in non-conventional gas- shale gas, coal bed methane develops with United States leading growth until 2020

- Improved and enhanced oil recovery- horizontal drilling, 4-D seismic, downhole enhancements
  - Oil resource/endowment 11 trillion barrels \((11 \times 10^{12} \text{ barrels})\)
  - Proven Reserves 1.382 trillion barrels \((1.38 \times 10^{12} \text{ barrels})\)
  - Historic Global Recovery factor 22%, 78% still in the ground!
  - Current global-averaged field recovery factor 22%
  - Improved/enhanced recovery could get to 70% recovery
  - Each 1% improvement yields 100 billion barrels which is equivalent to 5 years global supply

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\(^3\) IBM see internal combustion engines improved efficiencies of ~35% by 2030
## Energy Predictions

### Energy Mix

<table>
<thead>
<tr>
<th>Study</th>
<th>IEA</th>
<th>EIA</th>
<th>EXM</th>
<th>SHELL</th>
<th>BP</th>
<th>2030 forecast</th>
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<tbody>
<tr>
<td>Oil</td>
<td>27%</td>
<td>30%</td>
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<td>&quot;Scramble&quot;</td>
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<tr>
<td>Coal</td>
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<td>22%</td>
<td>25%</td>
<td>&quot;Scramble&quot;</td>
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<td>Nuclear</td>
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<tr>
<td>Green*</td>
<td>18%</td>
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### Scenarios

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<tr>
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<th>Current Policies</th>
<th>&quot;High&quot;</th>
<th>&quot;Reference&quot;</th>
<th>Single Scenario</th>
<th>&quot;Scramble&quot;</th>
<th>&quot;Blueprint&quot;</th>
<th>Single Scenario</th>
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<td>New Policies</td>
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<td>&quot;Low&quot;</td>
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<td>New Policies Case</td>
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<td>&quot;Blueprint&quot;</td>
<td>&quot;Scramble&quot;</td>
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### Oil Demand 2030

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<th>BP</th>
<th>2030 forecast</th>
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<tbody>
<tr>
<td>Oil</td>
<td>99mbd</td>
<td>110mbd- high case, 104mbd- low case</td>
<td>108mbd</td>
<td>N/A</td>
<td>103mbd</td>
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### Oil Price 2030

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<th>BP</th>
<th>2030 forecast</th>
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<tr>
<td>Oil</td>
<td>New Policies Case</td>
<td>$113/bbl</td>
<td>High Case</td>
<td>$210/bbl</td>
<td>N/A</td>
<td>N/A</td>
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<td>Gas</td>
<td>Reference Case</td>
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### Increase in overall energy demand

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<th>IEA</th>
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<th>EXM</th>
<th>SHELL</th>
<th>BP</th>
<th>2030 forecast</th>
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<tbody>
<tr>
<td>Oil</td>
<td>36%</td>
<td>49%</td>
<td>35%</td>
<td>38%</td>
<td>40%</td>
<td>(1.7% /yr)</td>
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### Headlines

- Oil dominates until 2035
- Gas demand increases by 44%
- Fossil fuel subsidies scrapped??
- Non-OECD demand overtakes OECD
- Gas growth 1.3% year-on-year
- Non-OECD GDP overtakes OECD beyond 2015
- Average Global GDP growth 3.0%/yr (reference case)
- Oil dominates beyond Non-OECD growth 60%
- Gas 60% growth
- TANIA- "there are no ideal answers"
- Supply struggles to keep pace w/demand
- OPEC provides 46% of supply
- China biggest oil consumer at 17.5 mbd in 2030
- Gas to Power grows 2.5%/yr
- Non-OECD 93% of growth
- Biofuels 6.5mbd
- Renewables grow at 8.2%/yr

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Green* = hydro, wind, tidal, wave, solar, biomass

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