Knowledge stream I
The Environmental Challenge

Christian Cleutinx

The Executive Training Programme for Tomorrow’s Energy Decision Makers

The Energy Charter Secretariat and Kazenergy

Astana 10-13 June 2014
Governments play an important role in the energy sector

Except in the US, states/governments have ownership of the subsurface (this exception is important in the US for the development of shale gas, tight oil,...)

they issue the :

- Exploration license
- Production license
- Permission for transportation route
- Take (partial or total) ownership / sit on board

And they manage the risk climate

- Verify and impose environmental rules
- Tax profits and economic rents
- Regulate markets
- Set investment conditions/ macroeconomic climate/ monetary policy
- Rule of Law

They also :

- Set bilateral and multilateral business frameworks (UN, WTO)
- Foreign/security/trade policies/trade promotion
- Provide capital/export capital/ex-imp banks
Energy future: Abundant but expensive

Finite and renewable energy reserves (TW/Year)

Renewable (Yearly potential) – Finite resources (total recoverable reserves)

Source: A fundamental look at energy reserves for the planet, Richard Perez and Marc Perez, 2009

Annual consumption 16 Tw/yr
Technology is important...
EU Energy consumption

Mio toe

Source: Eurostat February 2014.
Energy 2050 Roadmap: EU Hydrocarbons production

Mio toe

Treaty on the Functioning of the European Union
The building of an energy policy

Primary Law

**Article 122 (1) TFEU** Without prejudice to any other procedure provided for the treaties, the Council, on a proposal from the Commission, may decide, in a spirit of solidarity between Member States, upon the measures appropriate to the economic situation, in particular if severe difficulties arise in the supply of certain products, notably in the area of energy.

**Article 170 TFEU** deals with TEN in the area of energy infrastructure (principle introduced in the Maastricht Treaty under Article 129 b in 1992).

**Article 194 (1) TFEU** sets the four objectives of EU Energy policy
a) ensure the functioning of the energy market;
b) ensure security of energy supply in the Union;
c) promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
d) promote the interconnection of energy networks....

**BUT article 194 (2)** refers to the right of the Member State to determine its choice between different energy sources and article 194 (3) that fiscal matters require unanimity.
The diversity of the EU Energy Mix - 2015

Source: EU Energy, Transport and GHG Emissions Trends to 2050, European Commission, December 2013
Energy 2020 focused on five priorities

• An efficient use of energy that translates into 20% savings by 2020

• Building a truly pan-European integrated energy market

• Secure, safe and affordable energy for citizens and businesses

• Technological leadership delivering innovative and cost-efficient solutions

• Strong international partnership, notably with our neighbours
Share of Greenhouse Gas Emissions

- Energy: 79
- Agriculture: 10
- Industry Processes: 8
- Waste: 3

Legend:
- Energy
- Agriculture
- Industry Processes
- Waste
EU Energy targets: 20-20-20 by 2020

- Greenhouse gas levels: -20% (achieved by 2013, reduction in GHG: -18%)
- Energy consumption: -20%
- Renewables in energy mix: +20%

Energy Consumption: On the way to reach 18% in 2020

Results achieved by 2013
Reduction in GHG: -18%
Level of renewables: 13%

By 2020, these national targets will collectively deliver a reduction of around 10% of total EU emissions from the sectors covered compared with 2005 levels. Together with a 21% cut in emissions covered by the EU ETS, this would accomplish the overall emission reduction goal of a 20% cut below 1990 levels. The ETS covers around 45% of the EU GHG emissions. It limits emissions from more than 11,000 heavy energy industry installations in power generation and manufacturing industry. Limited to flights within Europe until 2016.
Binding Target: EU 2020 Share of renewable energy in final demand
Energy infrastructure at the heart of EU energy and climate policy

Why?
• Renewable energy
• Smart meters and smart grids
• Diversify sources of gas supply through new pipelines
• Functioning of the internal market
• Building permits take too long to obtain (up to 10 years to build an overhead electric line)
• Not all investments needed are commercially viable (e.g. reverse flow)

How?
• Number of projects of common interest within EU priority corridors
  - special granting procedure not exceeding 3 years (one stop shop)
  - eligible for EU funding – € 5.85 bn for the period 2014 – 2020 (Connecting Europe Facility)
EU Energy Infrastructures 2010 - 2020

Capital expenditure in the electricity and natural gas sector
+/- 1.1 trillion €

- Power Generation:
  +/- 500 bn €
  - Renewables
    +/- 340 bn €

- Transmission and distribution
  +/- 600 bn €
  - Transmission
    +/- 200 bn €
  - Distribution
    +/- 400 bn

- Electricity
  +/- 140 bn €

- Natural Gas
  +/- 70 bn €
Proposal for a EU 2030 Climate and Energy Framework  
(January 22 2014)

• 2030 binding target for a reduction in GHG of 40 % from 1990 levels
• 2030 binding target at EU level for 27 % renewables
• On energy efficiency currently no target but a 40 % GHG emissions reduction target would require an increased level of energy savings of 25 % in 2030

• Proposal for a market stability reserve for phase 4 of the EU ETS beginning in 2021 to prevent surplus allowances depressing carbon prices: if total number of allowances in circulations reaches 1.2 bn, 12 % of the allowances would be placed into the reserve; there would be a release of allowances if the number falls below 400 mio (automatically 100 mio allowances would be released or if for more than 6 months the carbon price is more than 3x the average carbon price in the previous 2 years all allowances would be released. Allowances would be withdrawn in each Member State pro rata the total amount to be auctioned by national authorities

• Non binding recommendation on measures to ensure that shale gas exploitation addresses environmental and safety risks
• New key indicators: energy price differentials, import diversification, share of indigenous energy, smart grids and interconnections, intra-EU coupling of energy markets, competition and market concentration, technological innovation

• New governance framework would require each Member State to have a « national plan for competitive, secure and sustainable energy » making a clear commitment towards renewable energy taking into account EU law and including the objectives on non ETS GHG emissions, renewable energy, energy savings, energy security,... Where the Commission’s review of national plans indicates that the EU’s renewable energy target would not be met, it would seek to reinforce these plans as required.
Proposal for a EU 2030 Climate and Energy Framework
Impact assessment

• Reference scenario current policies: - 32% GHG, 24% RES, 21% Energy savings
• Costs related to ambitious GHG targets are relatively limited if targets are met in a cost effective way
• Ambitious EE and RES have a positive impact on external fuel bill (€18 bn/year), health (pollutant emissions) – Benefits €7-13.5 bn in 2030, GDP and jobs: shift away from fuel expenditure towards capital expenditure (€38 bn/year up to 2030)
• Energy efficiency is key to contain energy costs increases
• Global climate efforts will have positive impact on EU competitiveness
Energy 2050 Roadmap scenarios

**BAU Scenarios - Policies underway and proposed by the European Commission as of …**

- Reference (March 2010)
- Current Policy Initiatives (as of April 2011)

**Result:** GHG emissions about 40% below 1990 by 2050

**Decarbonisation Scenarios (New Policies to be eventually proposed to reach GHG emissions 80% below 1990 by 2050)**

- High Energy Efficiency
- Diversified Supply Technologies
- High Renewables
- Delayed CCS
- Low Nuclear
The 20/20/20 targets in 2020 (in force since 2009)

**Binding Targets**

- 20% share of renewable energy in final energy demand (as compared to 1990 -10 % RES in transport)
- 20 % GHG reduction as compared to 1990

**Indicative Target**

- 20 % energy efficiency (with respect to estimated energy demand in 2020)

**Emission trading scheme**
The signalling of governments about their long term intentions can change the market dynamics.

Energy roadmap 2050, a case of backcasting based on 80% reduction of GHG emissions. It is often treated as forecasting or as a policy action plan.
Basis of scenarios: 80% reduction in domestic GHG emissions by 2050

Conclusion on efficient pathway:
-25% in 2020
-40% in 2030
-60% in 2040

Decarbonisation scenarios

(Low-Carbon Economy Roadmap - March 2011)

Source: European Commission
Primary Consumption in 2050

European Commission: Energy roadmap 2050,
Energy 2050 Roadmap: Energy Dependency (%)

Energy imports in 2050:
- Highest: 1165 Mtoe
- Lowest: 413 Mtoe
EU 2050 Roadmap: Gas Imports (000 toe)
A spread in 2050 of 222 million toe (242 bcm)

Source: European Commission, Energy Roadmap 2050
Energy 2050 Roadmap: Oil Imports (000 toe)
A spread in 2050 of 463 million toe (9.3 million barrels/day)

Source: European Commission, Energy Roadmap 2050
Energy 2050 Roadmap
Share of Nuclear in Electricity
Energy 2050 Roadmap
Share of Renewables

![Chart showing the share of renewables in gross final energy consumption from 2000 to 2050 for different scenarios: Current policy initiatives, High EE, Diversified supply technologies, High RES, Delayed CCS, and Low nuclear.](chart.png)
Nuclear power plants in Europe

Under construction
Finland 1
France  1
Russia 11
Slovakia 2
Ukraine 2
Natural Gas Prices (May 30 2014)

Source : Ycharts
EU : Average EU Border Price. Includes UK.
Natural gas prices (1) and oil prices (2)

(1) Russian Natural Gas border price in Germany, US Dollars per Thousands of Cubic Meters
(2) Oil price (Dated Brent)
Source: IMF, Nov. 2013
Comparison EU and US Gas Prices

RU NG : Russian Natural Gas border price in Germany, US$ per Million Metric British Thermal Unit
US NG : Natural Gas spot price at the Henry Hub terminal in Louisiana, US$ per Million Metric British Thermal Unit
Source IMF : June 2014
Prices for Natural Gas

Source: East European Gas Analysis, 2014
## Production Cost of Natural Gas (US$ mmBTU)

<table>
<thead>
<tr>
<th>Region</th>
<th>Conventional *</th>
<th>Shale gas*</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>3 - 7</td>
<td>3 - 7</td>
</tr>
<tr>
<td>EU</td>
<td>5 - 9</td>
<td>5 - 10</td>
</tr>
<tr>
<td>China</td>
<td>4 - 8</td>
<td>4 - 8</td>
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<tr>
<td>Russia</td>
<td>0 – 2 (1) 3 – 7 (2)</td>
<td>-</td>
</tr>
<tr>
<td>Qatar</td>
<td>0 - 2</td>
<td></td>
</tr>
</tbody>
</table>

(1) West Siberia       (2) East Siberia

**Cost of liquefaction : 3 – 4.5
**Shipping : 1 - 2.5
**Regasification : .3 – 0.5
Total : 4.3 - 7.5

Sources : *AIE and **industry estimates
Global distribution of unconventional gas

Source: IHS CERA, NPC
Shale gas in Europe

Best estimate technically recoverable reserves shale gas
W Europe : 12 tcm
E Europe   : 4 tcm

Production cost : WE Low 4.4 - Best 7 - High 21 $/mmbtu

## EU LNG Import Capacity

<table>
<thead>
<tr>
<th>Number</th>
<th>Capacity (bcm)</th>
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<tbody>
<tr>
<td>Existing (2012)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>193</td>
</tr>
<tr>
<td>Under construction/</td>
<td></td>
</tr>
<tr>
<td>Committed</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Under study/planned</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>160</td>
</tr>
</tbody>
</table>

- 2012 imports: 59 bcm  Degree of capacity utilisation: 30%
- 2013 imports (est.): 45 bcm  Degree of capacity utilisation: 23%
LNG : Low degree of capacity utilisation

<table>
<thead>
<tr>
<th>Country</th>
<th>TWh</th>
<th>LNG Net Imports</th>
<th>% Change 2012/2011</th>
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<tbody>
<tr>
<td>BELGIUM</td>
<td>29.9</td>
<td></td>
<td>-3%</td>
</tr>
<tr>
<td>FRANCE</td>
<td>114.2</td>
<td></td>
<td>-30%</td>
</tr>
<tr>
<td>GREECE</td>
<td>14.8</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>ITALY</td>
<td>77.1</td>
<td></td>
<td>-18%</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>9.5</td>
<td></td>
<td>1%</td>
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<tr>
<td>PORTUGAL</td>
<td>22.9</td>
<td></td>
<td>-30%</td>
</tr>
<tr>
<td>SPAIN</td>
<td>215.0</td>
<td></td>
<td>-16%</td>
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<tr>
<td>UNITED KINGDOM</td>
<td>147.9</td>
<td></td>
<td>-45%</td>
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<tr>
<td><strong>EU-28</strong></td>
<td>631.3</td>
<td></td>
<td>-28%</td>
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Production capacity

2012  193 bcm  30 %
2013  199 bcm  23 %

Estimated 2013: 45 bcm
Regasification Capacity in Europe
in bcm/y

Total LNG capacity

Total LNG capacity excl. planned capacity of new facilities

Source: Gas infrastructure Europe
Pros and cons of shale gas

Pros:
- Shale gas production contributes to the country's energy security.
- Shale gas can reduce energy imports and cut down environmental conventional gas production.
- Shale gas can provide energy when renewable energy sources fail to meet peak demand.
- Shale gas production generates new ideas for use in other forms of energy production (e.g., electricity).
- Shale gas can be produced safely.
- Shale gas production has lower greenhouse gas emissions per unit of energy than coal and oil.
- Shale gas production can provide jobs and training.

Cons:
- Shale gas production has higher greenhouse gas emissions per unit of energy than conventional gas production.
- Shale gas production reduces the risk of nuclear power and other energy sources.
- Shale gas production can cause significant environmental and safety issues.
- Shale gas production can lead to increased water usage and contamination.

What are the arguments for and against production of shale gas for EU member states with shale gas resources?

For:
- Shale gas production can reduce energy imports and cut down on environmental conventional gas production.
- Shale gas production can provide energy when renewable energy sources fail to meet peak demand.
- Shale gas production can be produced safely.
- Shale gas production has lower greenhouse gas emissions per unit of energy than coal and oil.
- Shale gas production can provide jobs and training.

Against:
- Shale gas production has higher greenhouse gas emissions per unit of energy than conventional gas production.
- Shale gas production reduces the risk of nuclear power and other energy sources.
- Shale gas production can cause significant environmental and safety issues.
- Shale gas production can lead to increased water usage and contamination.

Large scale shale gas production may weaken the national economy in the long term.
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Cheap shale gas in Europe: limited hope

- Exploration expenditures greater than in the US
- Higher cost of drilling and completion
- Important investments in infrastructure
- Slower procedures, strict controls
- Nimby (in Europe underground mineral fuels belong to the state – in the US belong to the landowner) and even Banana: Build Absolutely Nothing Anywhere Near Anyone. In the US a landowner with 100 acres of Marcellus shale can expect $2 million in royalties over 20 years.
- No large history of onshore drilling and limited expertise
- Will not change the supply equation
US Shale Gas: exports or no exports

- Political battle over expansion of gas exports: “Exports could harm the nation’s (US) ability to reach energy independence, combat pollution and preserve the environment and improve the economic competitiveness of American manufacturers”... “US might shortchange its newfound domestic energy security with increased exports”
- Could provide some relief as far as EU source diversification is concerned
- But export market would stabilise US prices (reduce the volatility of the market) and encourage more gas-directed exploration
- Up to now six provisional export licenses and Sabine Pass Liquefaction Project is fully licensed
- US not a low cost producer in terms of lifting costs
- Handicap for renewables (low prices for electricity from gas)
- Extremely high initial decline rates of wells with steep trends (may lose more than 85% of their initial output within the first 12 to 18 months) – significant decrease in the recovery factor
- TX Barnett and La Haynesville formations: to keep production flat needed in one year 2000 new production wells. Bakken shale: it takes 2500 new wells to sustain oil output of 1 million b/d, Iraq could do the same with 60. Break even for US Shale oil estimated at $60 to 80 $ a barrel.
- Recovery efficiency of 8 to 12% contrasting significantly with recovery efficiencies of 75 to 80% for conventional gas fields
Comparison evolution natural gas and coal prices

Source: World Bank

Freight Port Bolivar-ARA: $10-13

$75/t = $3.1/mmbtu
EU Evolution of coal consumption (1990 = 100)
EU ETS

• The EU ETS works on the 'cap and trade' principle. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. Covers 11 000 factories with a net heath in excess of 20 MW responsible for close to 50 % of EU CO2 emissions The cap is reduced over time so that total emissions fall. In 2020, emissions from sectors covered by the EU ETS will be 21% lower than in 2005.

• Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value.

• After each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so.

• However, the ETS faces a challenge in the form of a growing surplus of allowances (almost 2 billion allowances) , largely because of the economic crisis which has depressed emissions more than anticipated. In the short term this surplus risks undermining the orderly functioning of the carbon market; in the longer term it could affect the ability of the EU ETS to meet more demanding emission reduction targets cost-effectively.

• In January 2014, decision to postpone until 2019-2020 (or 'back-load') the auctioning of 900 million allowances as an immediate measure, while also launching a debate on structural measures which could provide a sustainable solution to the surplus in the longer term. The Commission proposes a market stability reserve in 2021. In addition, proposal for an increase in the linear reduction factor which determines the EU ETS cap to 2.2 % per year from 2021, from 1.74 currently.
The structural reform debate

- **Rapid accumulation**
- **Back-loading**
- **Persistent surplus**

*Blue columns represent actual data; Green columns represent projections.*

European Commission, DG Climate Action, Presentation Jos Delbeke, Carbon Expo 2014
The CO2 market in the EU (2008 – 2014)

- Debates on 20/20/20 targets
- Economic and financial crisis
- Sluggish economic recovery
- Fukushima nuclear catastrophe
- Energy efficiency directive
- Debt crisis
- Com. proposal on backloading
- Adoption of backloading and proposal of a framework for climate and energy policies up to 2030
- Negative vote on backloading by ITRE EP
Estimates of the prospective annual abatement cost in €/t of avoided emissions of GHG i.e. annual additional operating cost (including depreciation) less potential cost savings (costs are negative if the cost savings are considerable)

Source: McKinsey, 2010
EU: The real price of CO2

€/tonne CO2

Source: David Hone, 2013, Shell Company.
China CO2 emission gap (1)

... To compare with the total CO2 emissions of the EU power and steam generation and district heating in 2015: 1.4 GT CO2

(1) Source: Nature Climate Change, June 11, 2012
But: EU 15 overachieves first Kyoto Target and is on the right track to overachieve the EU 28 target of 20%

- In 2012, EU 15 emissions stood 15.1 below their base-year level
- EU 15 emissions averaged 11.8 % below base year levels during the 2008-2012 period and so overachieved its first Kyoto target by a wide margin
- For 2020 the EU 28 has made unilateral commitment to reduce GHG by 20 % compared to 1990 levels
- While GDP grew by 45 % between 1990 and 2012, total GHG emissions were 19.2 below the 1990 level
- Latest projections show that total GHG emissions in 2020 will be 22.2 % below the 1990 level