

WEC Long Term Energy Scenario Drivers

6th December 2011, Paris

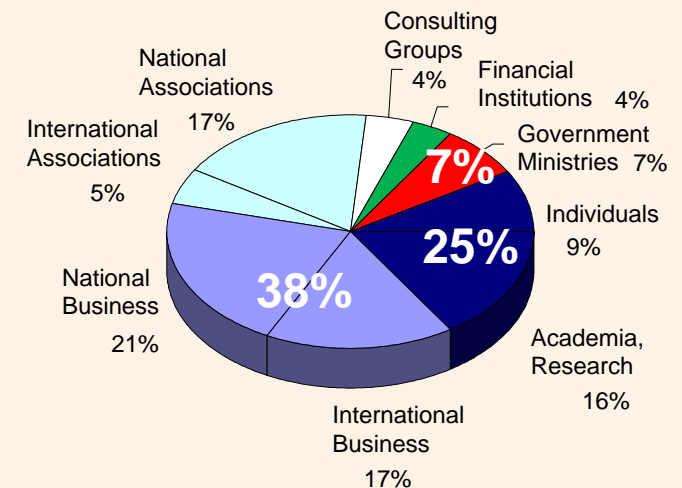
Promoting sustainable energy for the greatest benefit of all



World Energy Council – who we are

- The World Energy Council is the **only truly global and inclusive* forum** for thought-leadership and tangible engagement committed to our **sustainable energy future**; *public & private sectors, developing & industrialized countries, producing & consuming countries, all technologies & resources
- Established in **1923** to help rebuild the electricity grid in Europe after WWI, first Congress in 1924; today, covers all technologies and resources
- With over **90 national committees** (including e.g. all BRICs), we represent over **3000** government, private sector and experts **organisations**
- National committees are chaired by **energy ministers, leading CEOs or experts**
- The Council's impartiality is ensured by its governance with the **Executive Assembly (one country one voice)**, our Officers Council, presided by WEC's Chairman, with the Secretary General in the executive function
- Our flagship event is the **World Energy Congress** held every three years; next in **Daegu, Korea, 2013**, with 4000 participants

WEC Membership Breakdown
(based on data from 30 MCs)



2557 member organisations in
67 of total 93 assessed MCs
(status 2009)

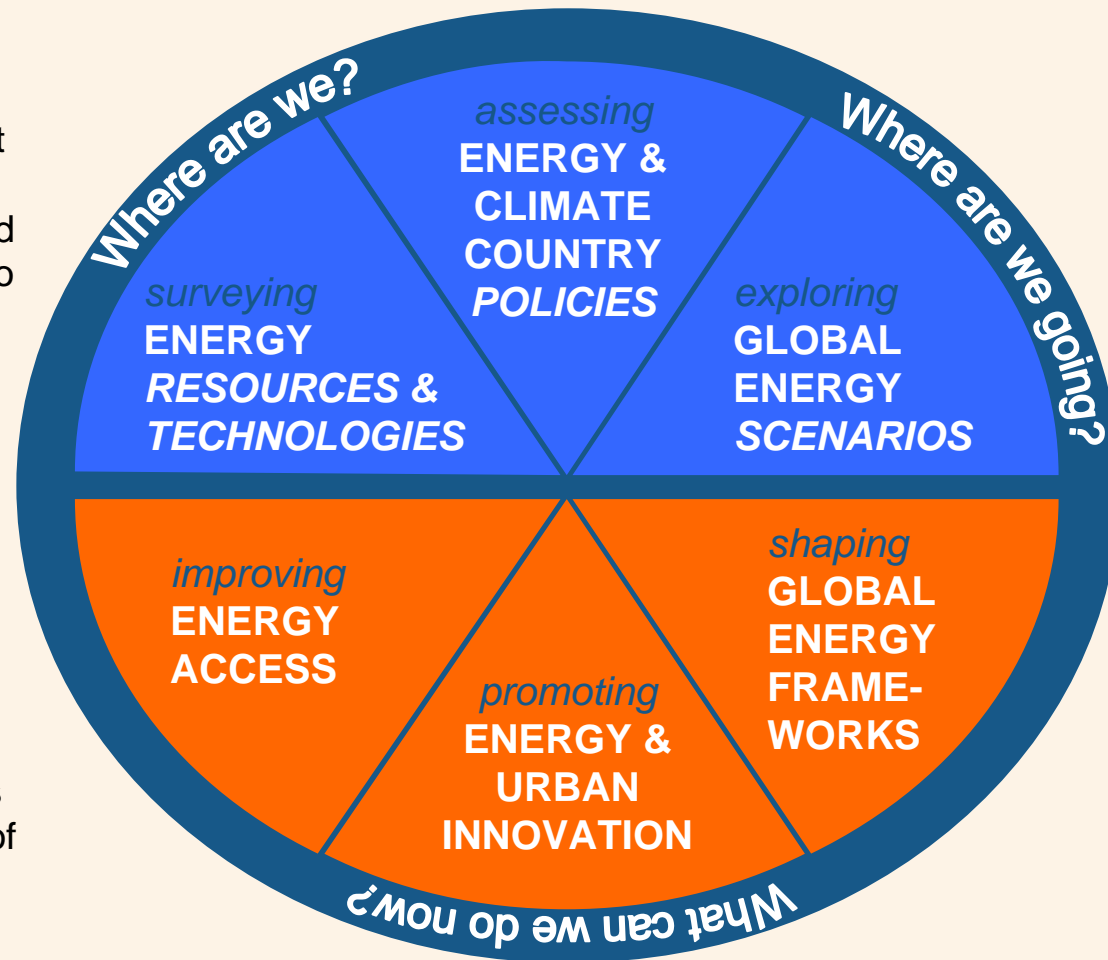
WEC's activity areas – what we do

FLAGSHIP PROCESSES

Policy and strategy relevant insight processes with annual updates (e.g. focus area deep-dives), based on **own methodology and data**, to support sound and robust decision processes of our key constituents (ministers & CEOs).

GLOBAL & REGIONAL AGENDAS

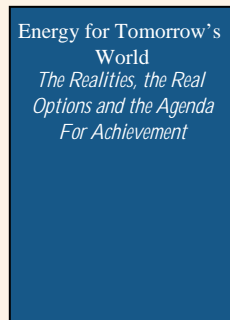
Action and outcome oriented processes where we directly engage and work with relevant stakeholders to **advance agendas** through exchange and promotion of best practices and building of partnerships.



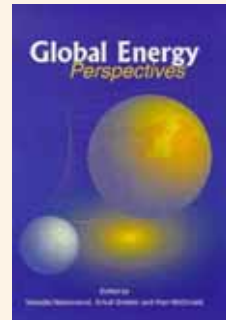
Integrated, annual publication with consistent format:
WORLD ENERGY INSIGHT 20

WEC energy scenarios – new pathways to our energy future

The World Energy Council has been involved with energy futures for more than two decades. WEC's first comprehensive study on energy, with a long term vision, combining both global and regional perspectives, was the groundbreaking "Energy for Tomorrow's World", 1993. Since then, WEC has been producing scenario-based studies consistently. The most recent WEC Scenarios study (2007) is class apart, with its main focus on policy. This is a first among energy scenarios studies. The new global energy scenarios 2050 will be finished by 2012



Energy for Tomorrow's World (1993)



Global Energy Perspectives (1998)



Deciding the Future (2007)

Traditional Approach – Top-down

- Many recent external in-depth studies of the sustainability of energy systems
- Most provide a strong top-down perspective from experts
- There is a focus on macro-economic and global or regional energy aspects.

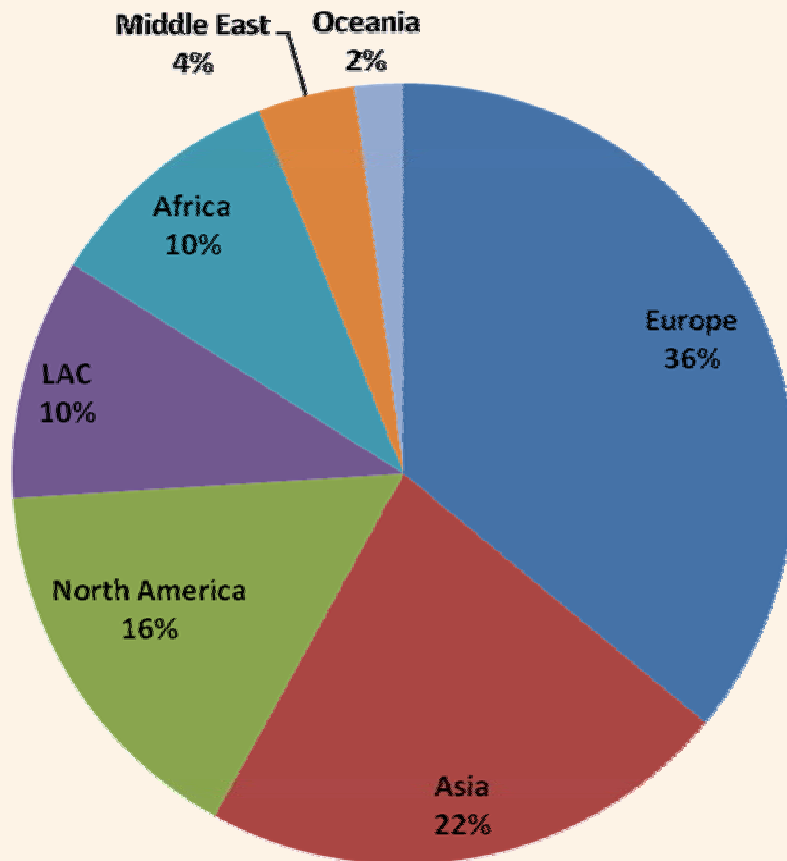
The new global energy scenario exercise to 2050:

- Will be bottom-up, harnessing the knowledge embedded within WEC network of member committees
- Global, qualitative and descriptive picture of key issues and driving forces in the energy landscape
- Provide regional insights for public discussion
- Will include open source modelling of energy system



Overview of Scenarios Study Group

Regional Membership



- 50 members from 25 countries
- Project Partner: IBM
- Some of the organisations represented -
 1. Sonelgaz (Algeria)
 2. Wien Energy (Austria)
 3. Verbund AG (Austria)
 4. Eletrobras (Brazil)
 5. Petrobras (Brazil)
 6. EDF (France)
 7. Areva (France)
 8. GDF Suez (France)
 9. RWE AG (Germany)
 10. Siemens AG (Germany)
 11. ESSAR (India)
 12. Tokyo Gas (Japan)
 13. PEMEX (Mexico)
 14. REN Servicos (Portugal)
 15. Sasol (South Africa)
 16. Eskom (South Africa)
 17. Repsol (Spain)

Scenarios Core Team

Executive Chair

Rob Whitney, CRL Energy
(New Zealand)

Executive Vice-Chair

Hans-Wilhelm Schiffer, RWE
AG (Germany)

Director (Policies & Scenarios)

Karl Rose, WEC

Sr. Project Manager

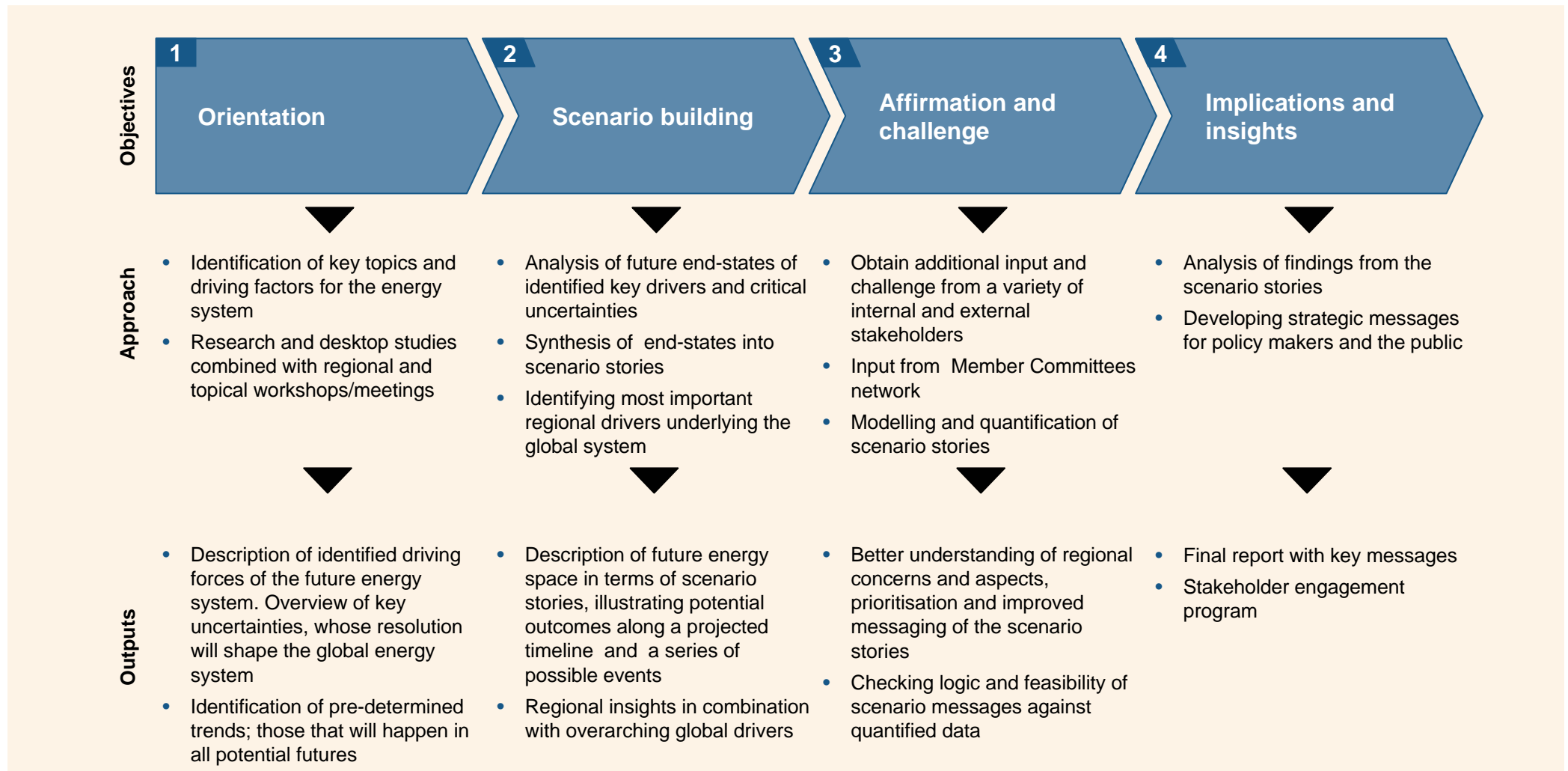
Ayed Qahtani, Saudi Aramco

Project Manager

Philip Thomas, WEC



WEC energy scenarios 2050 – process steps





Project timeline

2011									2012						
Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Discussion Topics							Writing Stories	Challenge & Affirmation					Finalizing		
							Building & Testing Model (Quantification)								

Project Stages*

Orientation & Synthesis: Feb 2011 – Nov 2011

Building: Nov 2011 – Jan 2012

Challenge & Affirmation: Jan 2012 – Jul 2012

Regional Workshops conducted in 2011

Johannesburg	Feb 28
Bangkok	Mar 26
London	May 4 (on-site Scenarios SG meeting)
Thessaloniki	June 2-3
Washington D.C.	June 21
Rio de Janeiro	Sep 13
Houston	Oct 31 – Nov 2
London	Nov 14-15 (on-site Scenarios SG meeting)

Scenarios Project Partners

Main Project Partners:

IBM – Project Partner – 10 members involved in Study Group

Paul Scherrer Institute (PSI) – Modelling Partner

Regional Project Partnerships:

WEC-ALADI Project – Latin America Region

Other Partnerships:

Chatham House – active participation of experts in workshops



5 Workstreams & 29 Issues

Economics/Finance/Trade	Energy Systems & Technologies	Resource Availability/Access	Consumer Behaviour & Acceptance	Government Policies
Super-Cycles vs. Boom and Bust?	Energy Efficiency	Reserves - coal, oil, gas, rare earths, etc.	Costs vs Values	Climate change & Environment
Population & Megacities	Technology - supply & demand side	Security of supply/demand	Leadership - state vs. private groups	Competitiveness, price, affordability
Investment in infrastructure	Technology - Environmental	Geopolitics - MENA instability	Acceptance	Demand management & energy Efficiency
Prices of energy-commodities-CO2	Smart Grids (incl. interconnectivity)	Competition for resources		Energy mix
Rise of China	Renewables (true associated costs)	Energy-Water Nexus		R&D
Globalization & Trade	Mobility	Energy Poverty		Security of supply
	Nuclear	Land use and access		

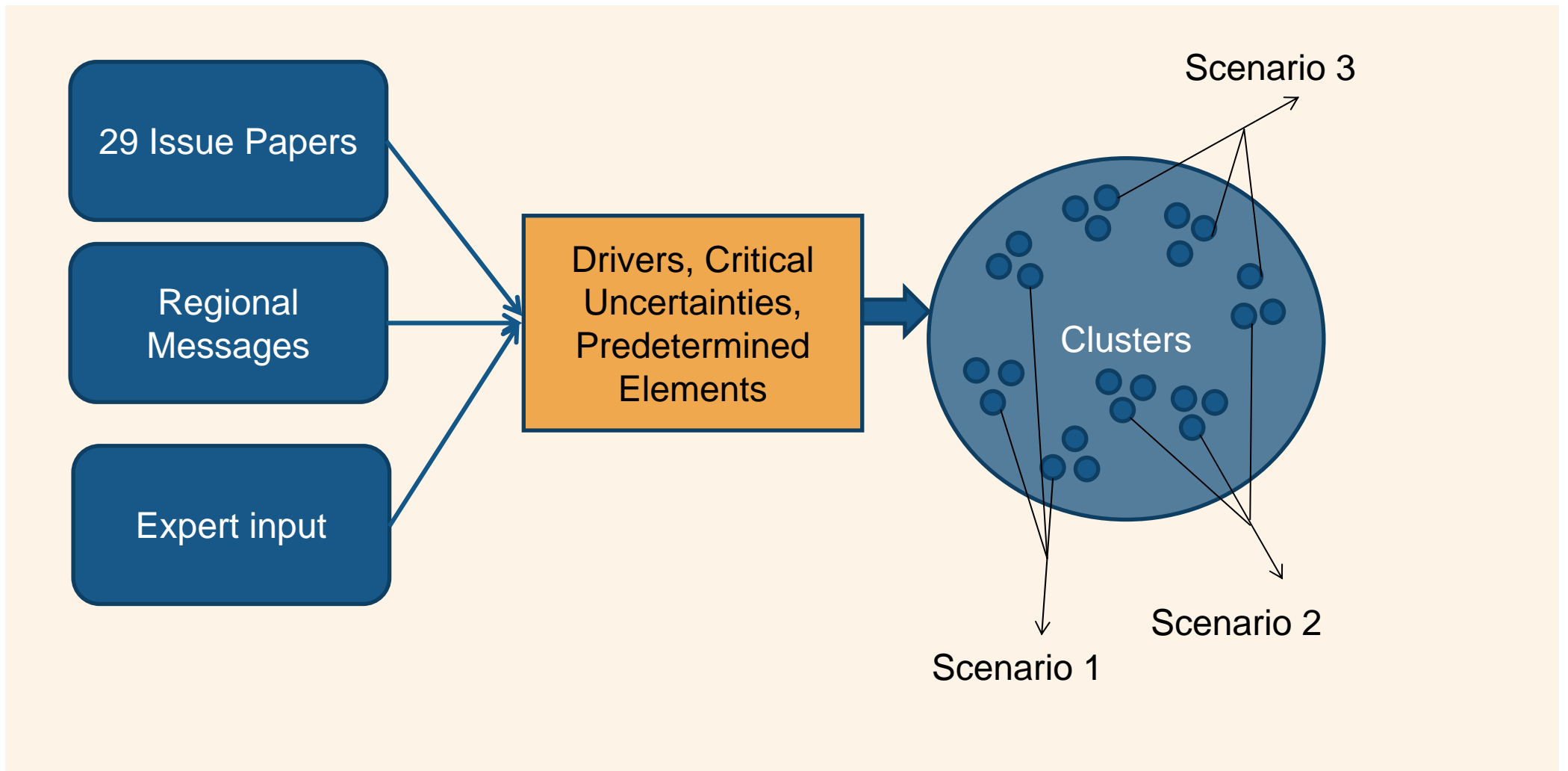
- Study Group was organised into 5 workstreams
- Lead authors were identified for each issue paper
- Contributing authors assisted lead authors in writing issue papers
- 447 page background document prepared by Study Group

First insights from discussion papers

- World of conflicting interests- deep social tensions: balancing those interests will be a key priority for policy makers
- Energy efficiency will be a must !!
- Energy poverty and access to energy in developing countries another critical driver
- Water and food shortfalls by 2030
- Fossil fuels and especially gas will play a major role for decades , shortfalls by 2050
- CCS will be very late to come
- Strongly increasing prices for industry, manufacturing and transport
- Competition for resources – resource nationalism
- Demand side management of increasing importance
- Public governance will be back in some areas, e.g. Europe



WEC scenarios construction



Mobility scenarios - drivers and uncertainties

Team identified and evaluated 11 major driving factors:

Factors	
1. Economic Growth 2. Demographic Trends 3. Megacities and Urbanization	Drivers
4. Geopolitics 5. Global Reserves and Supplies 6. Environmental and Health Concerns	
7. Policies and Regulations 8. Lifestyle Changes 9. Alternative Fuels 10. Fuel Efficiencies 11. Innovative Technologies	

Critical Uncertainties:

1. Government Regulation
2. Cooperation-Integration

Mobility scenario descriptions

Freeway	Tollway
<ul style="list-style-type: none"> • Market forces prevail and create climate for open global competition • Higher levels of privatisation, deregulation and liberalization • Supply surge in upstream, lower prices on short term, higher prices on long term • Market driven technology development and innovation • Patchwork of investment in major public infrastructure • Higher vehicle ownership levels and higher traffic and freight movements, especially in the East • Efficiency improvements in ICE, more CNG in transport • EVs and battery technology coming eventually from East to West • Biofuels mainly in Americas and EU 	<ul style="list-style-type: none"> • Common interest at forefront and government interventions in markets • More fragmented and differentiated world economy with local/regional interests prevailing • Lack of investments in upstream, high prices on short term, lower prices on long term • Public sector funding for infrastructure and “green projects” • Reduced dependence on fossil fuels • Strong emphasis on public transport solutions • Lower growth rates for shipping, aviation and truck transport • Earlier penetration of EVs and large scale use of electrification in public fleets • CNG and FCs in transport

More than 50 criteria are described & compared for the two scenarios in a 62 page report (available at www.worldenergy.org)

Mobility scenarios - few key messages

- Total fuel demand for global transport (30-82%)
- Number of cars more than doubles (2.2-2.6 folds)
- CO2 emission from global transport (16-79%)
- LDVs emission is about 20-32% of the total transport
- Policies are key!! Role of government is key!!
- Strong regional differences, varying priorities

London Scenarios Workshop

- 14-15 November, 2011 – The Athenaeum, London
 - 14 November: presentation & discussion of 29 issue papers
 - 15 November: presentation of regional messages, identification of drivers, critical uncertainties and predetermined trends, construction of draft scenarios
- 116 drivers considered in table discussions
- 15 key drivers identified by clustering
 - 2 critical uncertainties (role of the state, availability and source of funding)
 - 2 predetermined trends (megacities, energy/water nexus)
- 3 draft scenarios built
 - Scenario 1: State leads actively, people follow.
 - Scenario 2: State leads actively, people resist.
 - Scenario 3: State leads passively & sets frameworks

London Scenarios Workshop – key drivers

1. Role of State
2. Availability of Funds
3. Mitigation of CO₂
4. Equality
5. Global Economics
6. Energy Prices
7. Consumer/citizen acceptance
8. Energy Efficiency
9. Technology developments
10. Security of supply
11. China emerging
12. Energy Poverty
13. Energy Sources
14. Competition for resources
15. Skills shortages



Detailed description of drivers

		Clusters
State	(Uncertainty/Impact)	CO₂
<ol style="list-style-type: none"> 1. Role of the state in central planning and regulation (L/H) 2. Leadership (M/H) 3. Role of the state in regulating mobility choices (H/H) 4. Role of the state (H/H) <ol style="list-style-type: none"> a. Ability of the state b. Level of intervention c. Expectations of state 5. Role of the state – protectionism (H/H) 6. Strength of stakeholders – top-down vs. bottom-up (M/H) <ol style="list-style-type: none"> a. Role of media b. Democratic movements in states c. International agreements 		<ol style="list-style-type: none"> 1. Climate change (H/H) 2. CCS (H/H) 3. Availability of cost effective technology (H/H) <ol style="list-style-type: none"> a. Breakthroughs in technology b. Maturity of technology/ costs 4. CCS – Understanding costs and legal frameworks (H/H) 5. International rules on CO₂ reductions and price of carbon (H/H)
Funds		Equality
<ol style="list-style-type: none"> 1. Investment in infrastructure (M/H) 2. Investment in infrastructure – buildings, transport, energy (L/H) 3. Government policy on R&D – private industry ROI expectations (H/H) 4. Role and capacity of state to deliver investment (H/H) 5. Public private investment in R&D (H/H) 6. Availability of capital (L/H) <ol style="list-style-type: none"> a. Internal stability influencing investment ability b. Public vs. private c. Distribution of capital 7. Funding from global markets/govts/international orgs (L/H) 8. Innovative financing for renewable energy projects (H/H) 9. Role of the state in ensuring available funds for energy infrastructure (H/H) 		<ol style="list-style-type: none"> 1. Decreasing energy poverty in developing countries (H/H) 2. Rising income inequalities (H/H) 3. Universal energy access (H/H) 4. Social tensions/ inequality (L/M) 5. Development of middle class income (L/H) 6. Willingness of consumer to participate (H/H) 7. Income of middle class – role of state in driving middle class (M/H)
Prices		Consumer
<ol style="list-style-type: none"> 1. Prices (H/H) 2. High oil price: \$150/barrel, 2011 level (H/H) 3. Stable gas price (H/M) 4. Role of state in prices and reserves of hydrocarbons (M/H) 5. Energy prices and affordability of technology (M/H) 		<ol style="list-style-type: none"> 1. Youth mobilization (H/H) 2. Consumption patterns of increasing younger population in developing countries (M/H) 3. Future consumer attitude (L/H) 4. Influenced by how youth grow up (L/H) <ol style="list-style-type: none"> a. Technology/smart phones b. Different transport needs c. Instant gratification d. Different status symbols 5. Shared transport (H/H) 6. Consumer status (H/H) 7. Consumer willingness to pay for acceptability and security: awareness, education , peer pressure (M/H)

London Scenarios Workshop – Some emerging messages

1. **Role of the state** is seen as crucial going forward – impact of regulation, intervention, and guidance.
2. Importance of **funding** from public and private sources for infrastructure and renewable energy.
3. **Skills shortage** as majority of senior engineers in energy industry are due to retire in the next 5 years.
4. Concern about **political instability**.
5. **Water stresses** due to increasing urbanisation and agricultural activity.
6. Challenge of meeting **rising middle class** demands in India and China.
7. **Consumer acceptance** and willingness to accept technology and price change is fundamental for transition to renewables future.

Scenarios Project – next steps

- 4 parallel workgroups:
 1. Texting, writing, describing scenarios
 2. Interviews
 3. Cross impact analysis
 4. Modelling & quantification
- Challenge and affirmation workshops
 - External input and challenge of assumptions
 - Verification by experts
 - Regional relevance
- Finalization of report
- Engaging policy-makers in strategic discussion using latest WEC Scenarios

London Scenarios Workshop – key drivers

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