Energy in transition - navigating through uncertainty

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Marsh 2014 NOC Conference
Dubai, 18 March 2014

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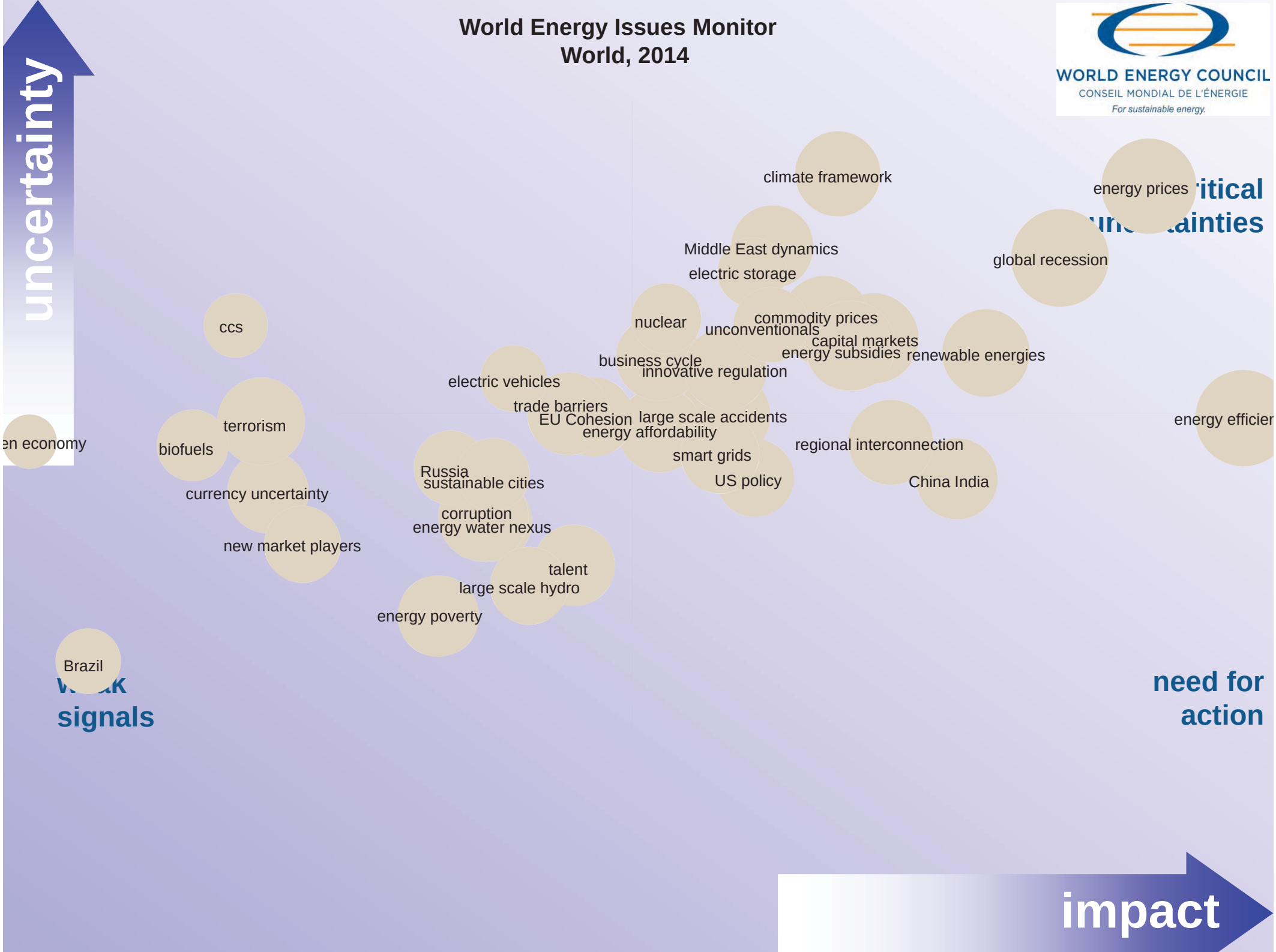
World Energy Issues Monitor
World, 2014



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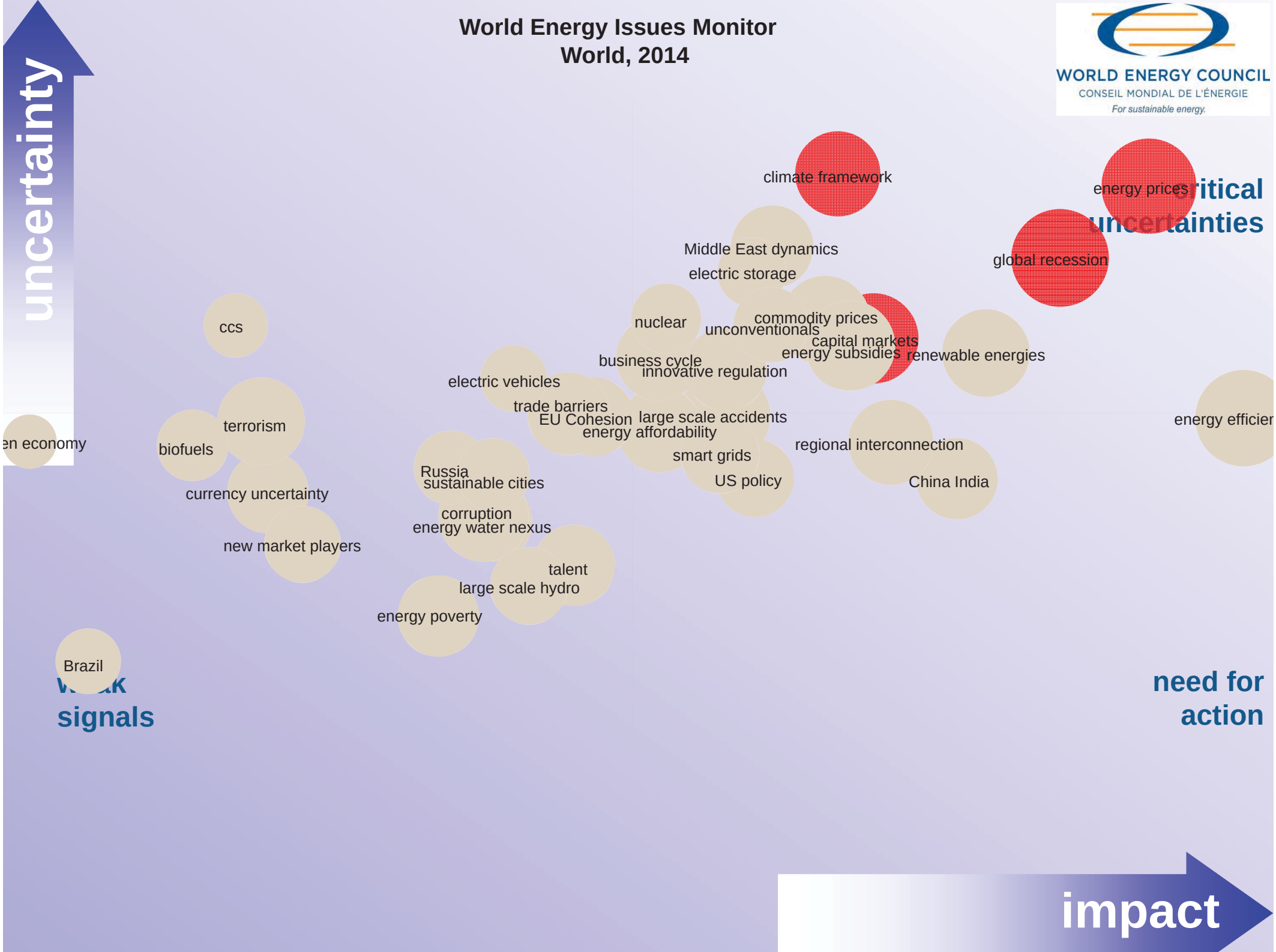

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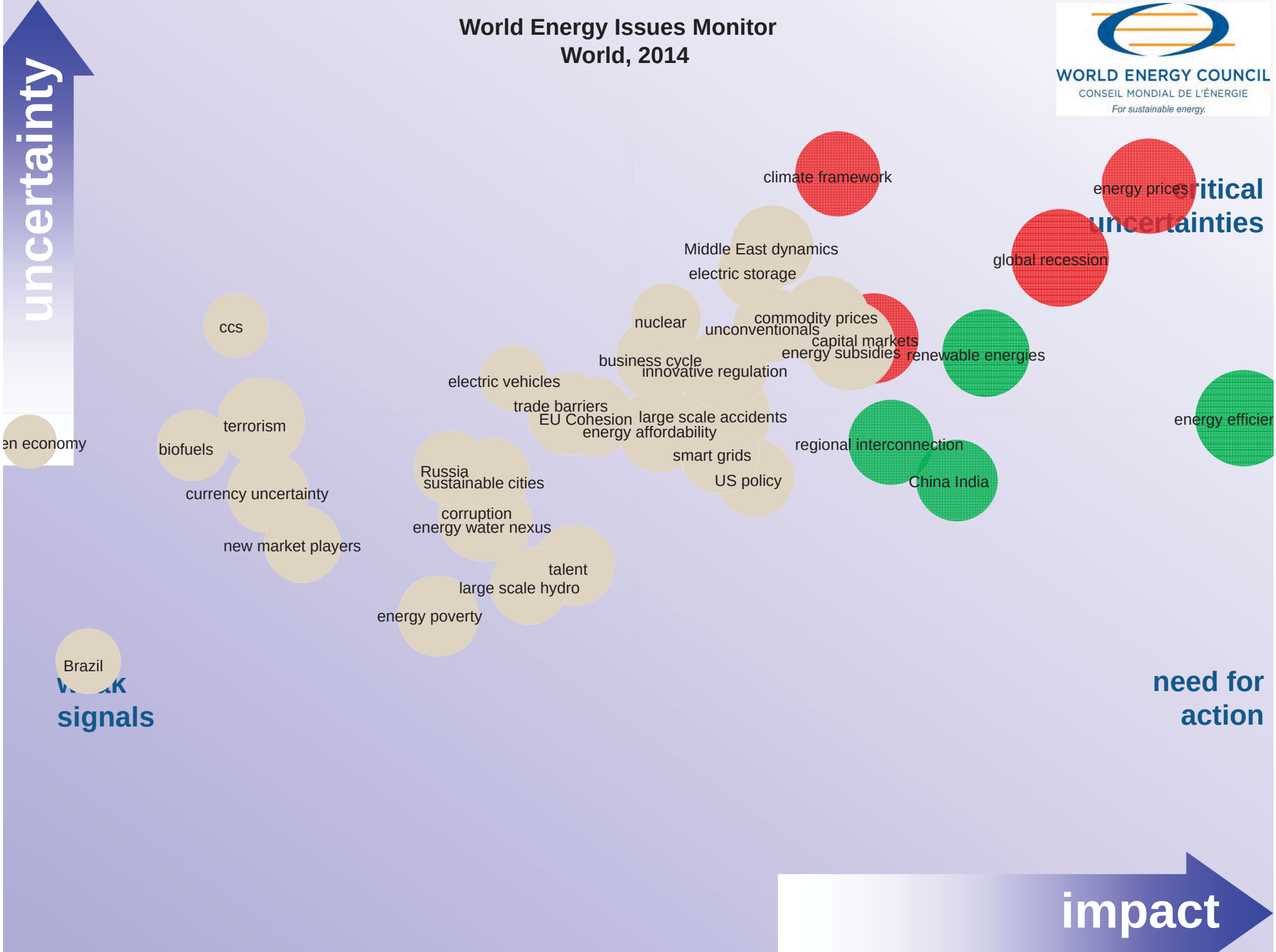

World Energy Issues Monitor
World, 2014
time tracking

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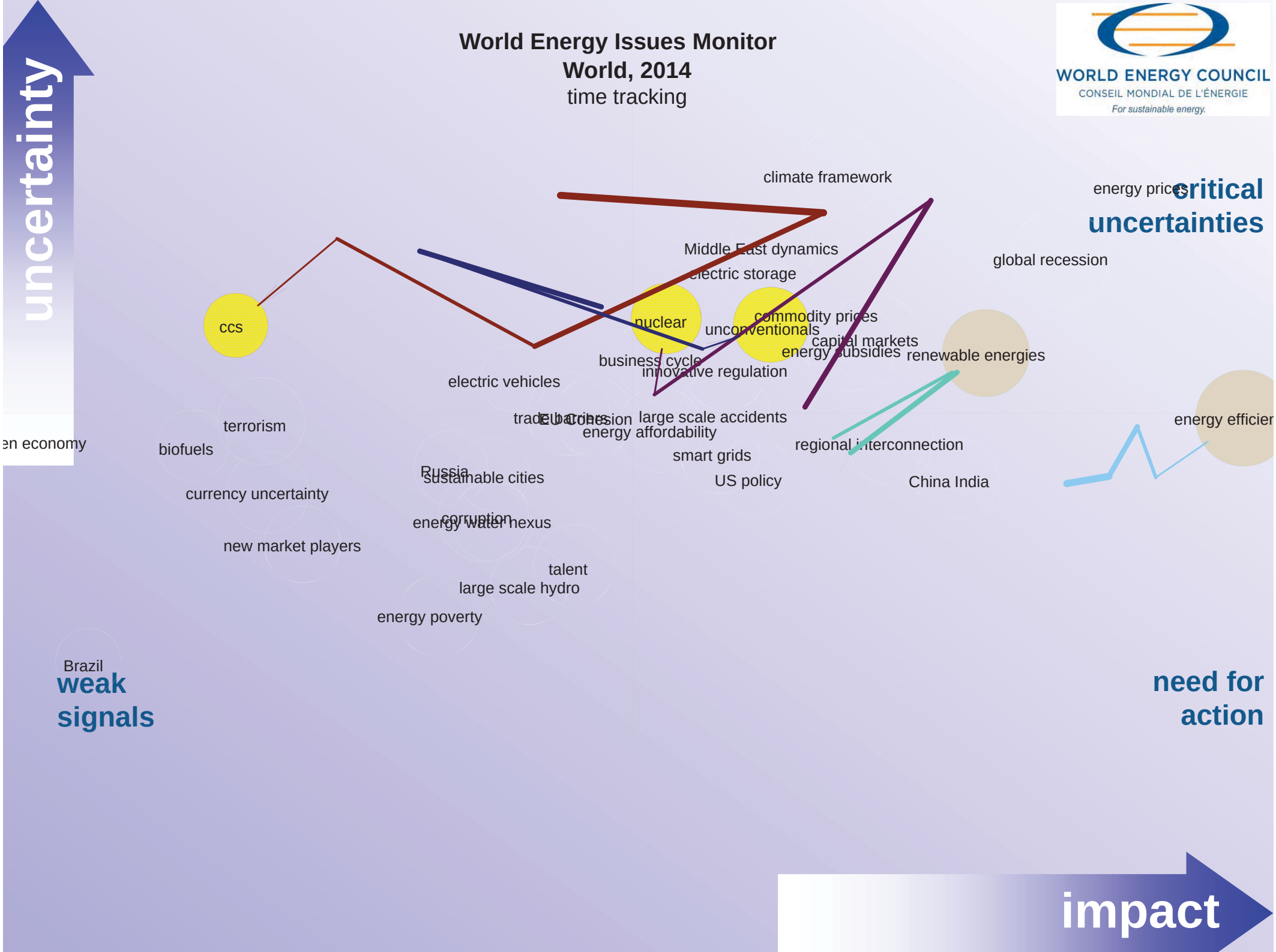

World Energy Issues Monitor
World, 2014

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uncertainty

geographical tracking:
energy efficiency

critical uncertainties

climate framework
energy prices
Middle East dynamics
global recession
electric storage
MENA
ccs
nuclear
unconventionals
commodity prices
capital markets
energy subsidies
renewable energies
NAm
business cycle
innovative regulation
electric vehicles
NonOECD
Europe
G20
terrorism
large scale accidents
energy affordability
Africa
biofuels
regional intercon
OECD
smart grids
Asia
Russia
US policy
sustainable cities
China India
currency uncertainty
corruption
energy water nexus
LatAm
new market players
talent
large scale hydro
energy poverty
Brazil

weak signals

need for action

impact

World Energy Issues Monitor
World, 2014

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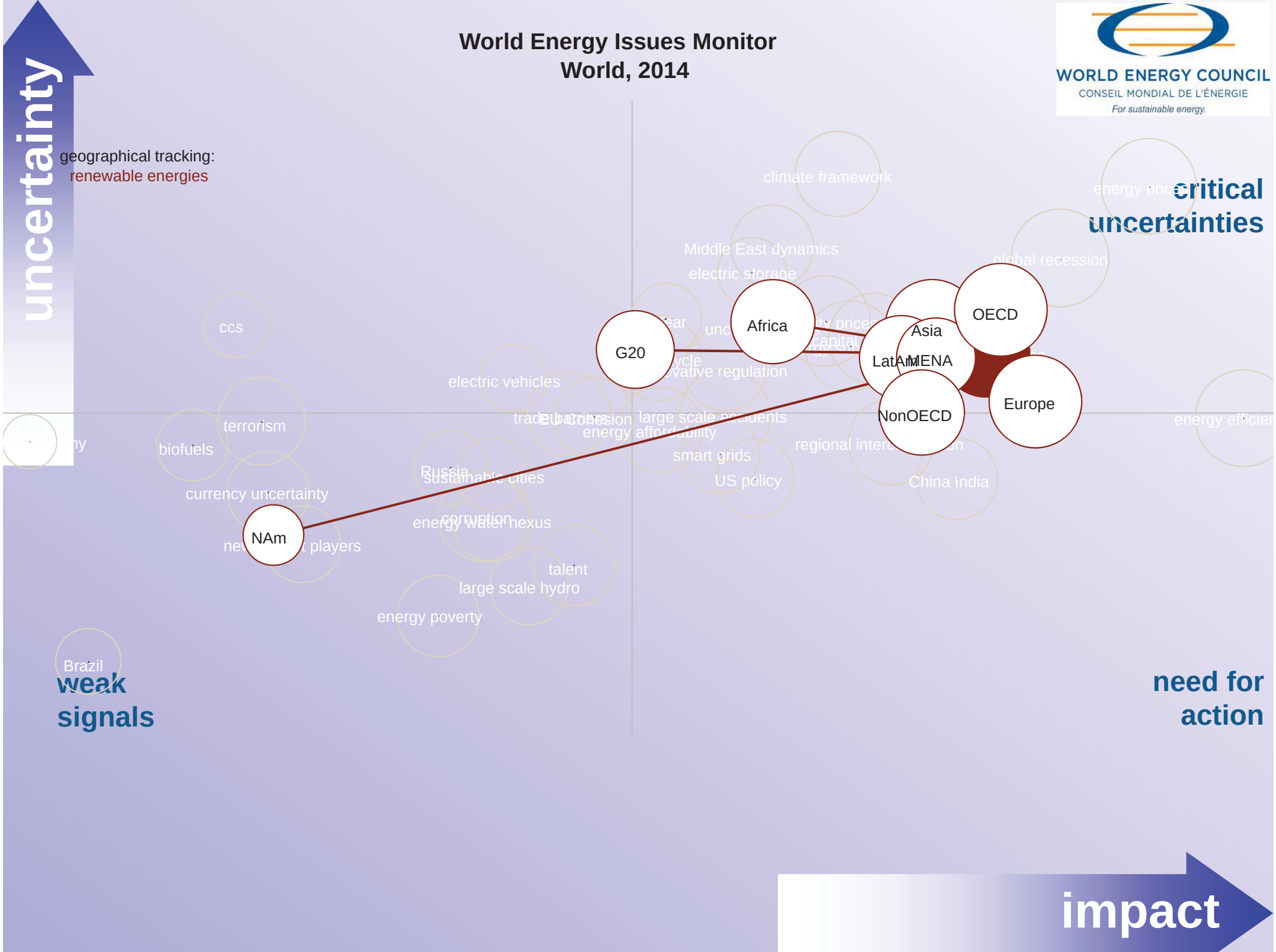

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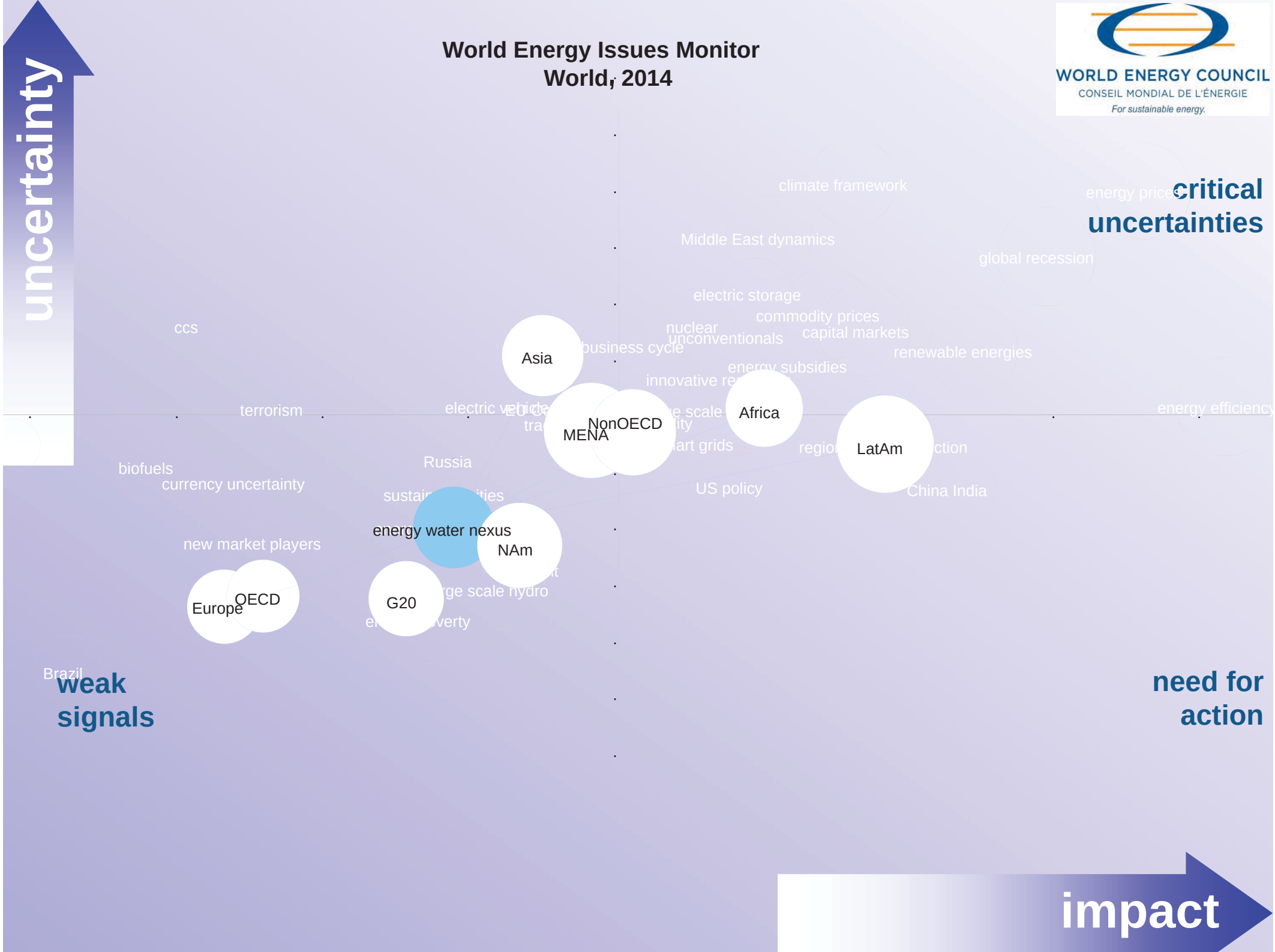
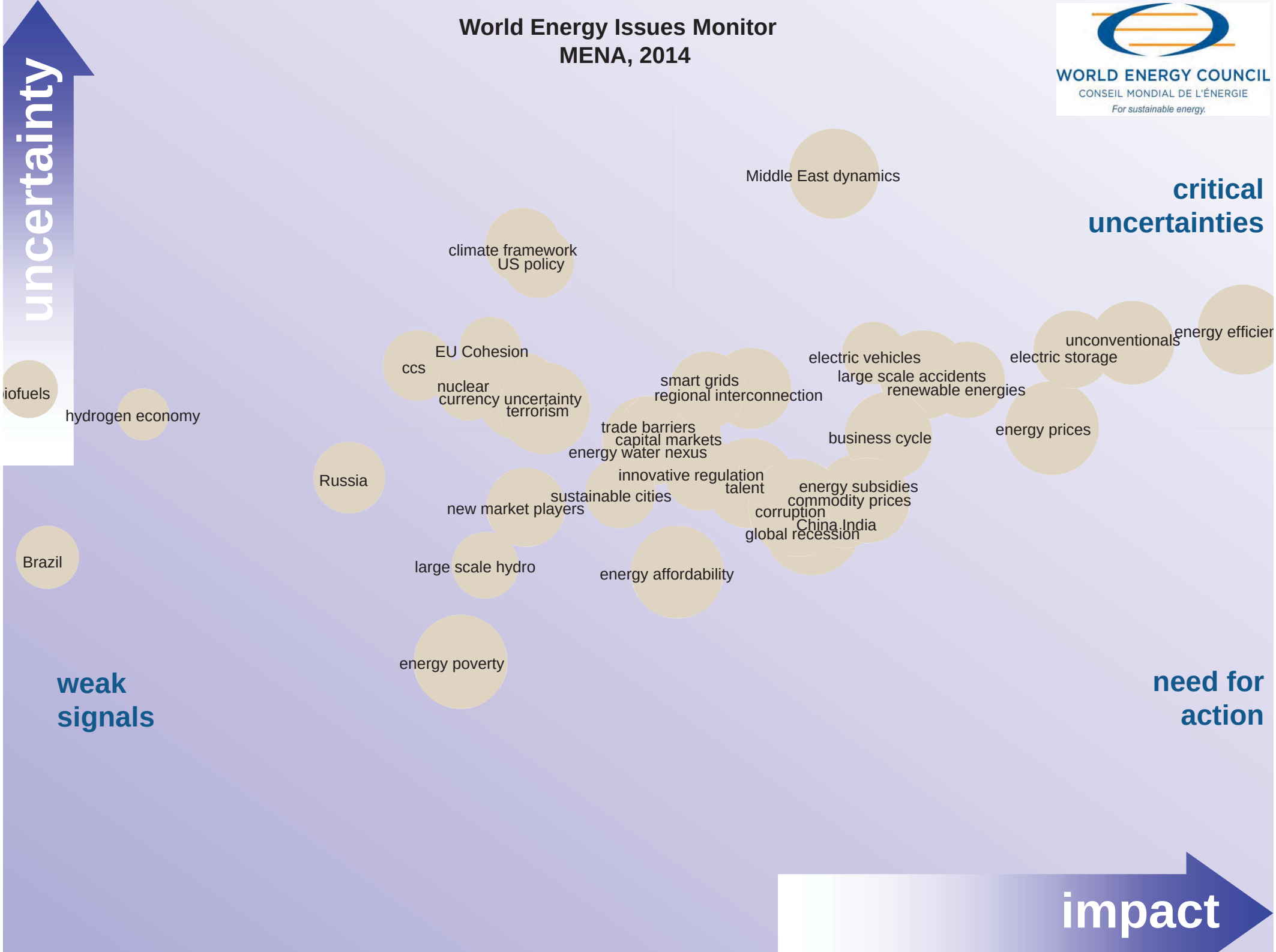


World Energy Issues Monitor
MENA, 2014



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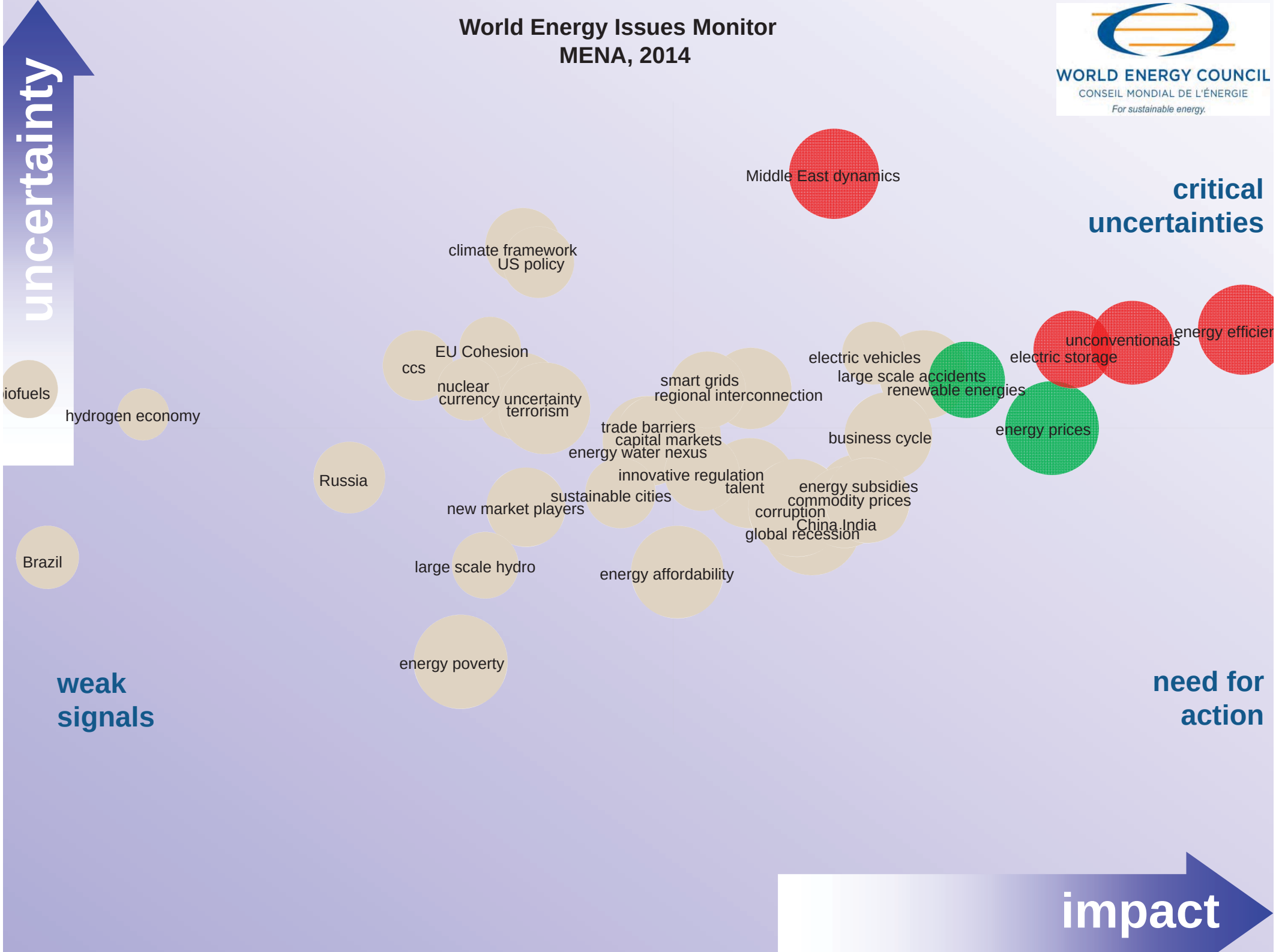
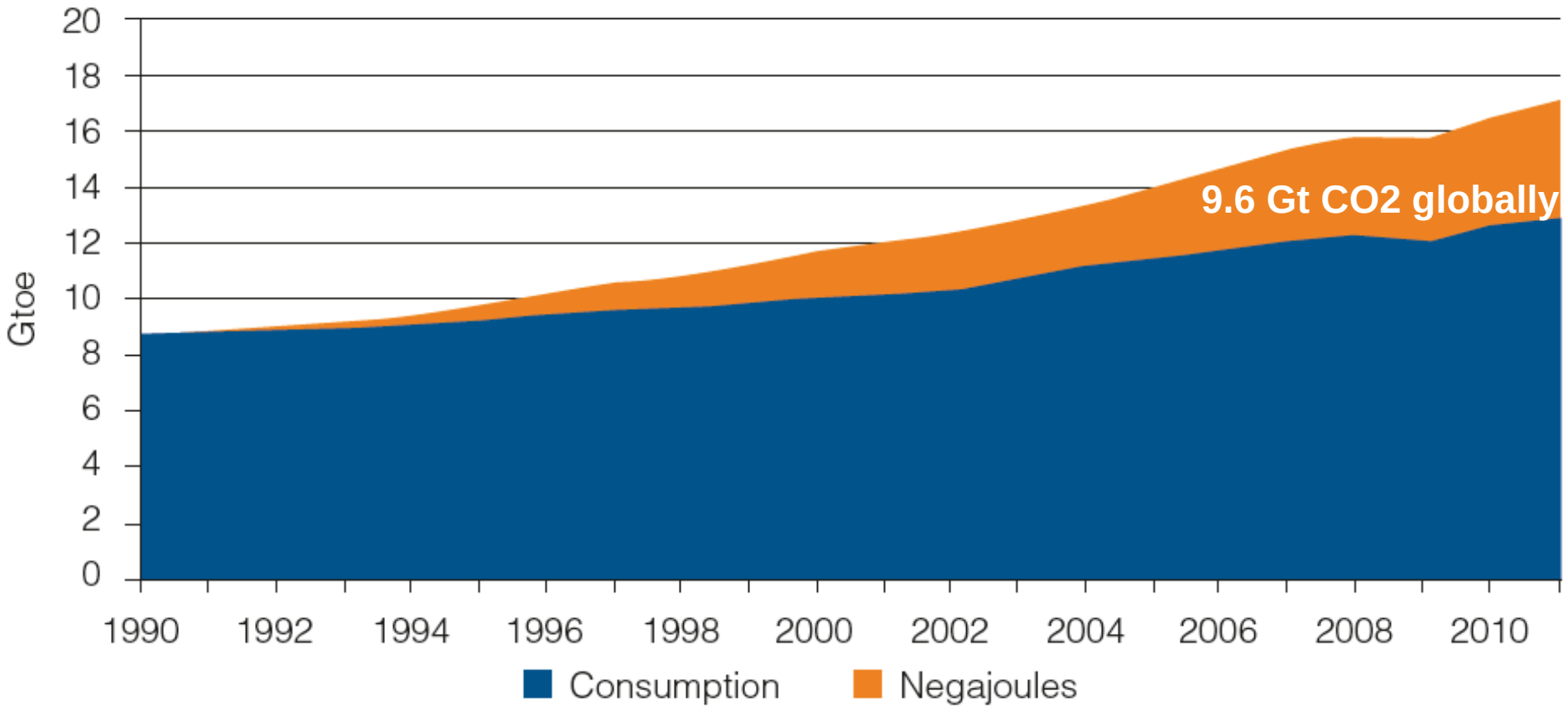


Energy Efficiency: Moderate progress worldwide…

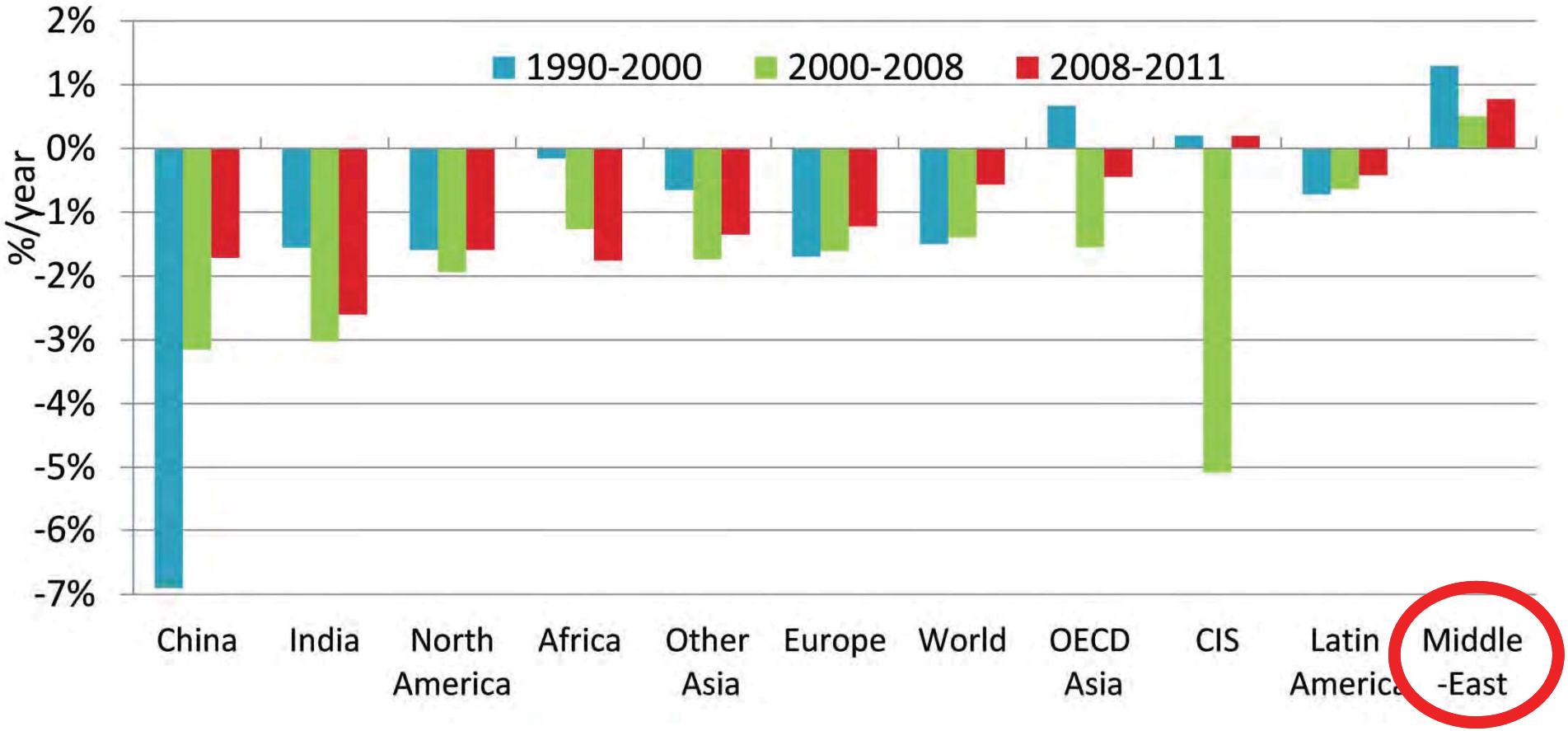
Source: World Energy Perspectives: Energy Efficiency Policies



Improvements in primary energy intensity, 1990 to 2011

Big regional disparities…

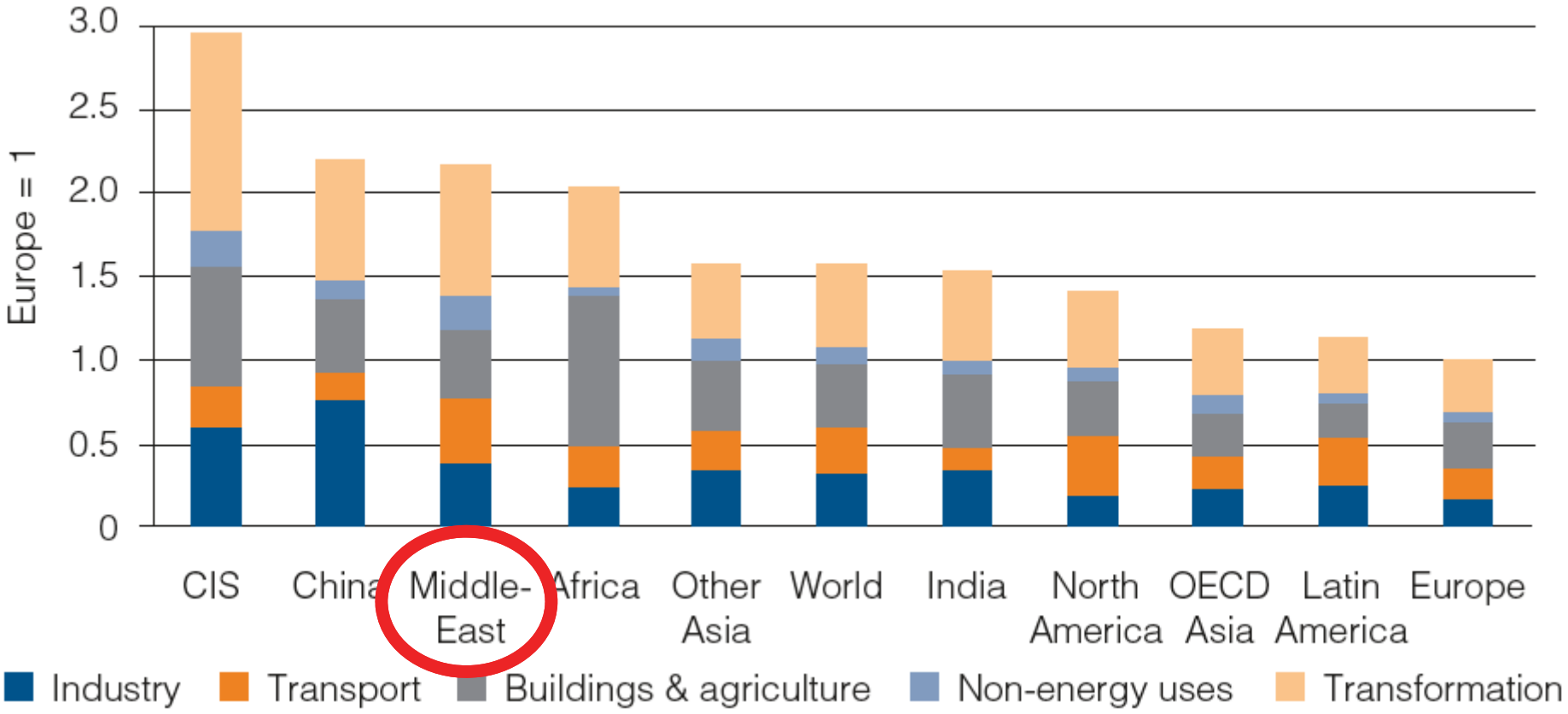
Source: World Energy Perspectives: Energy Efficiency Policies



Change in energy intensity by region

Challenges in transformation & transport…

Source: World Energy Perspectives: Energy Efficiency Policies



Industrial sectors shares in primary energy intensity (2011)

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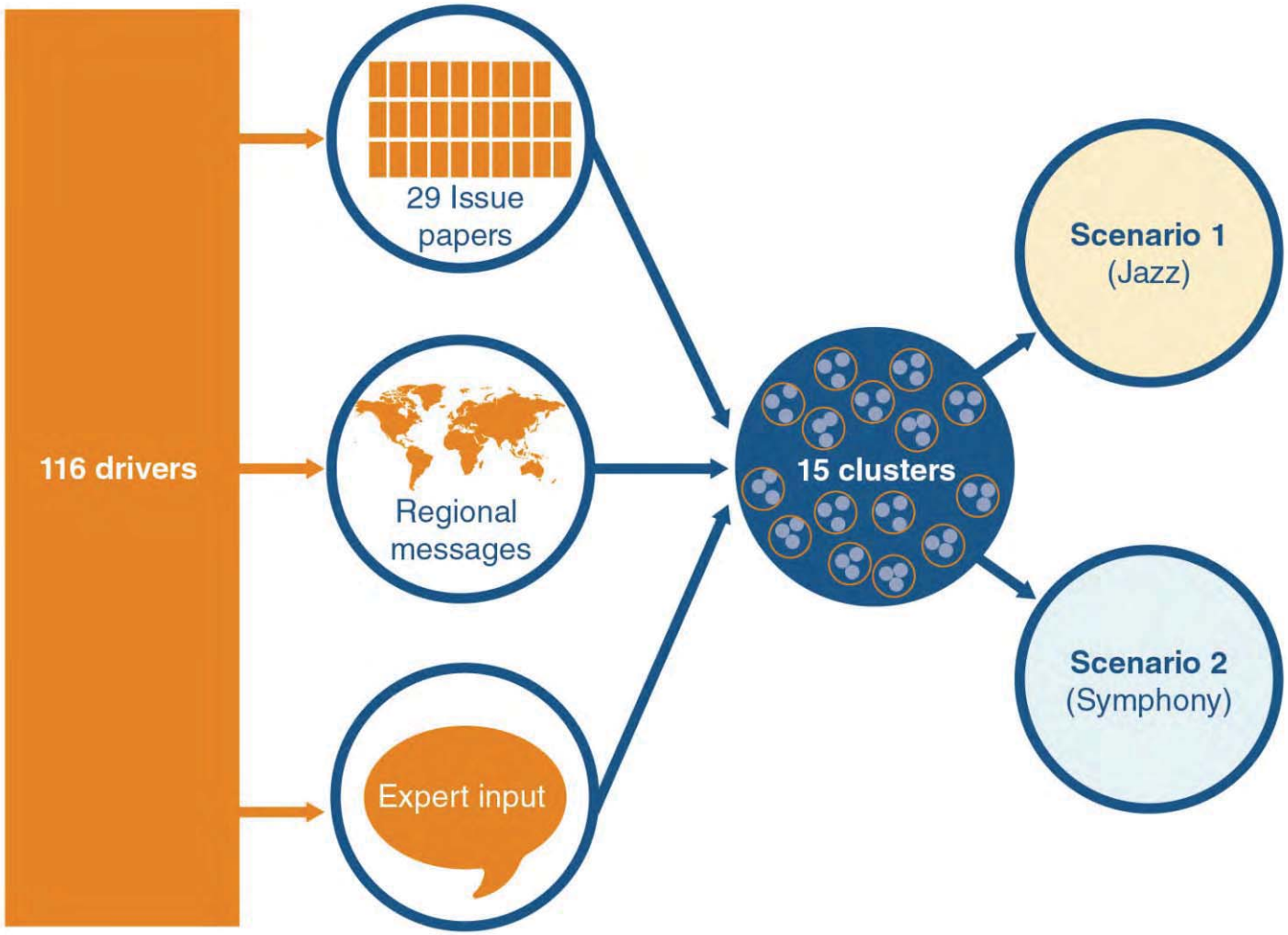
Project Partner:
Paul Scherrer Institute

World Energy Scenarios

Scenario Building Process



Key Clusters

1. Role of Government
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 and India
12. Energy Poverty
13. Energy Sources
14. Competition for resources
15. Skills shortages

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WEC Scenarios
Deriving the scenario stories

Two Scenarios stories, exploratory, different and equally probable rather than good and bad

Jazz:
Market & trade based, consumer driven, decentralized decision making, focussed on access and affordability. achieving growth through low cost energy. Governments facilitate GHG actions.

Symphony:
Government led, "orchestrated", voter driven, focussed on environmental goals and energy security, national and regional measures to increase share of renewables in energy mix. Binding international agreement on GHG emissions.

Storyline and quantification assumptions

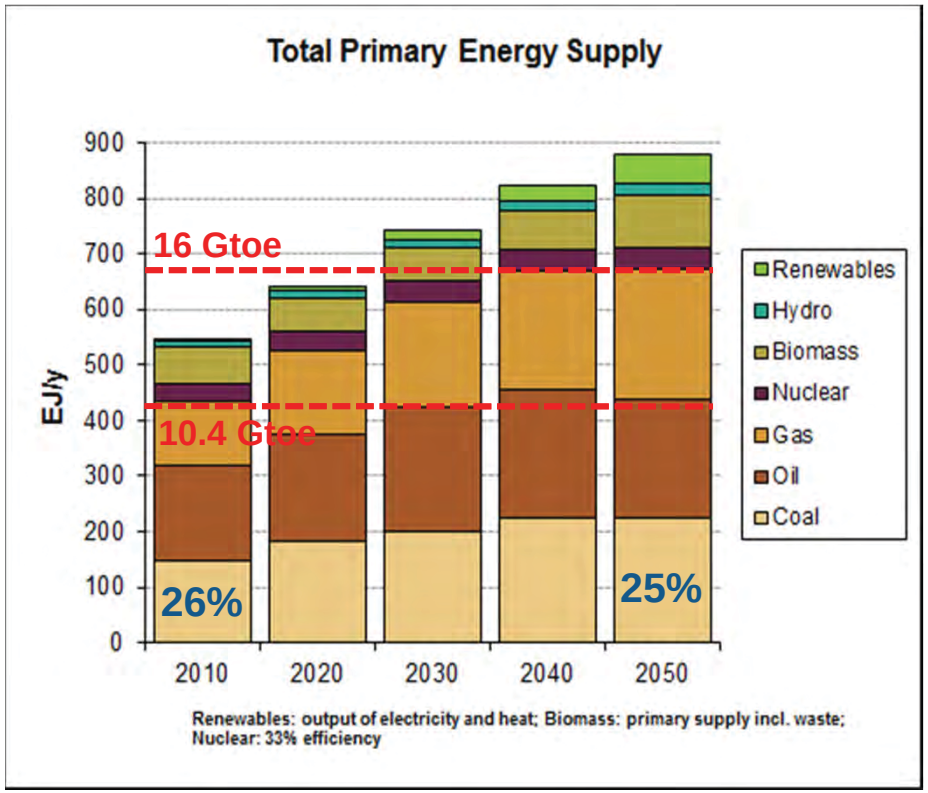
	Jazz	Symphony
GDP growth	**Higher** (3.54% pa CAGR, PPP)	**Lower** (3.06% pa CAGR, PPP)
Population	**Lower** (2050 = 8.7 billion)	**Higher** (2050 = 9.3 billion)
Efficiency/ Intensity	**Increasing** (-2.29% pa (primary, PPP))	**Increasing more strongly** (-2.44% pa (primary, PPP))
Climate policy	**Limited** Prices (2050): 23-45 USD/tCO_2	**Stronger** Prices (2050): 75-80 USD/tCO_2
Resources	Better access to **unconventionals**	More expensive **unconventionals**
Technology support	Limited; energy choice based on free markets	support for **nuclear**, **large hydro**, **CCS** and **renewables**
Technology innovation	Further development of CCGT decentralized power (SPV)	Focused R&D programs (esp. CC(U)S, solar PV)

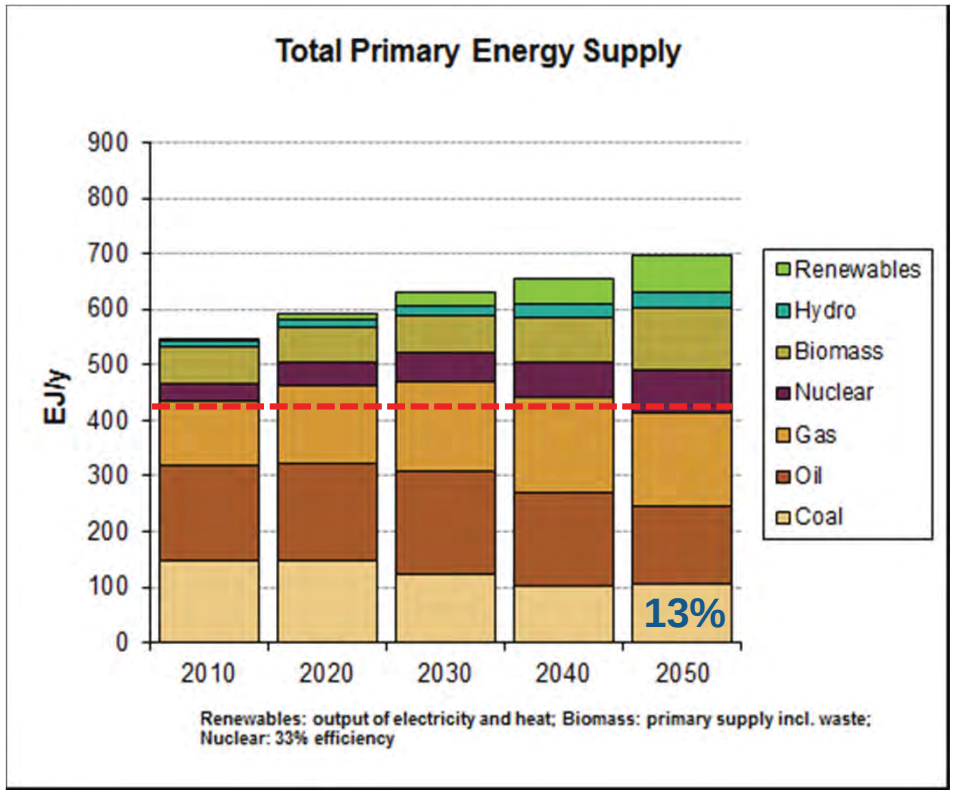
Highlighted results

	2010	Jazz, 2050	Symphony, 2050
Final demand	373 EJ	+69%	+31%
Fossil fuels *	80%	77%	59%
Renewables *	15%	19%	29%
CO2 emissions [Gt CO2/yr]	30.5	44.1	19.1
Solar **	0.2%	6%	16%
Wind **	2%	8%	8%
Nuclear **	13%	6%	15%
Hydro **	7%	11%	16%

* Shares in total primary energy supply
** Shares in electricity production

Global total primary energy supply





Jazz — **fossil fuels: +55%/- 5%** — **oil: +/- 15%**, **natural gas: +100%/+50%**, **coal: +/- 40%** — **Symphony**

Upstream liberalized;
technology development,
supply surge/more producers
Coal remains dominant in some regions

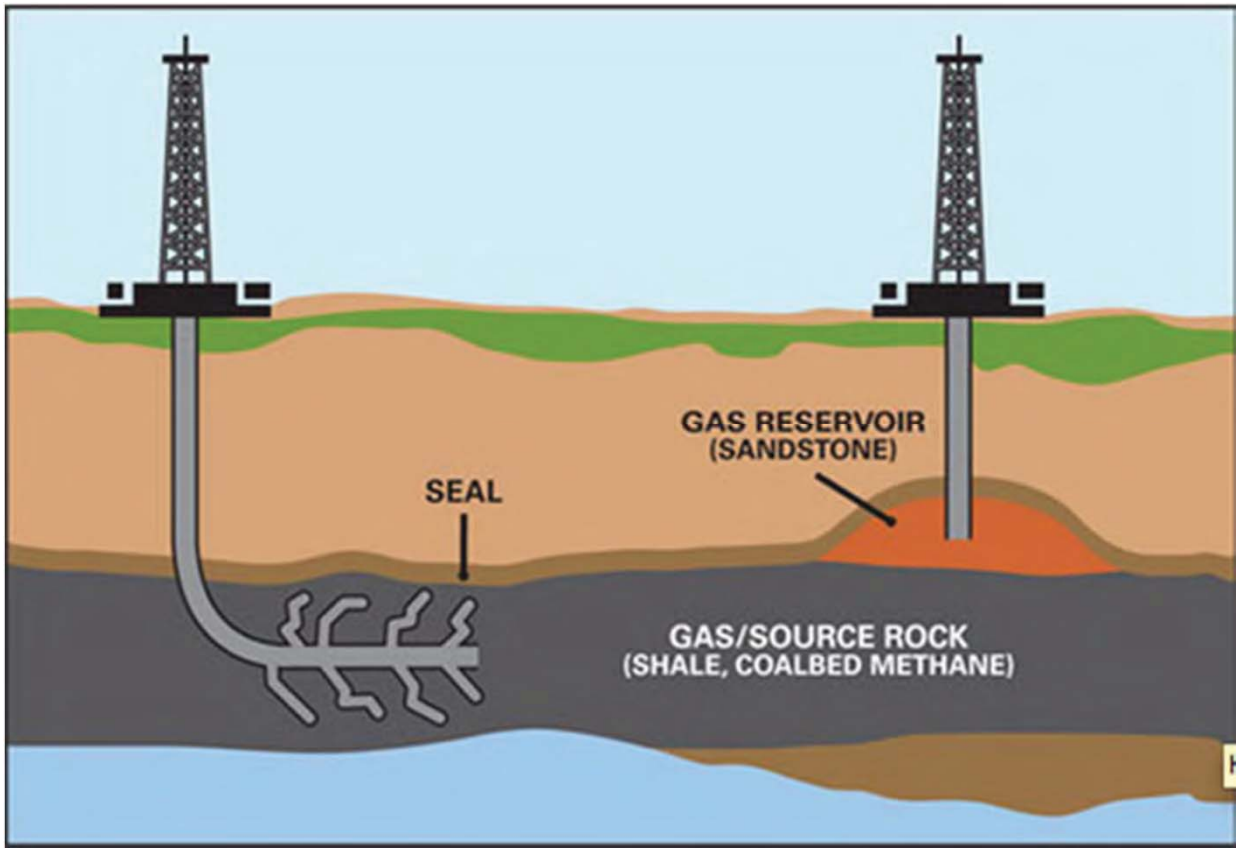
Tighter supply (lower E&P)
Higher infrastructure costs
Energy security drives reduced fossil use

Shale gas beyond the North America?

		tcf	tcm
1	China	1115	31.9
2	UK	910	26.0
3	Argentina	802	22.9
4	Algeria	707	20.2
5	Mexico	681	19.5
6	USA	665	19.0
7	Saudi Arabia	600	17.1
8	Canada	573	16.4
9	Australia	437	12.5
10	South Africa	390	11.1
11	Russia	285	8.1
12	Brazil	245	7.0
	WORLD	**>7000**	**>200**

Source: EIA, 2013, various

Globally only about 60 countries provide data on their shale resources; these data are still weak and often not backed by reliable data from exploration.



Source: www.carbonbrief.org

Shale gas opportunity in S-Africa?

10 factors potentially slowing down shale developments compared to the US

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- Subsurface, geological complexity and depth: US has a maritime basin with 1000-2000 m depth

Depth ca .3500 m; not enough information on geology; a few exploratory wells are needed to get better data that allow assessment of resource and geology **[!!]**

- Water constraints: US has rich water resources

Assessment of sourcing of fracking water and potential contamination of aquifers both depend on further knowledge on geology **[!!]**

- Population density could play a role in certain areas

Pristine land, mostly owned by farmers; proactive stakeholder engagement important

- Equipment constraints: US has large amounts of equipment available

Initial possibility of spare capacity in the international service companies; later, own equipment manufacturing to be considered

- Logistical constraints: US had existing roads to transport the equipment

Current roads are not designed for very heavy trucks; opportunity to get the industry involved to build

- Transport constraints: US had existing infrastructure / pipelines to transport the equipment

Initially, on site electricity generation and injection into transmission grid (up to 2-3 GW electric); later, building of relevant pipelines; regional natural gas interconnection master plan needed

- Technology experience and expertise: strong in the US

Build on existing experiences from in the mining & chemical industry

- Managerial experience and innovation culture: strong in the US

Build on existing experiences from in the mining & chemical industry

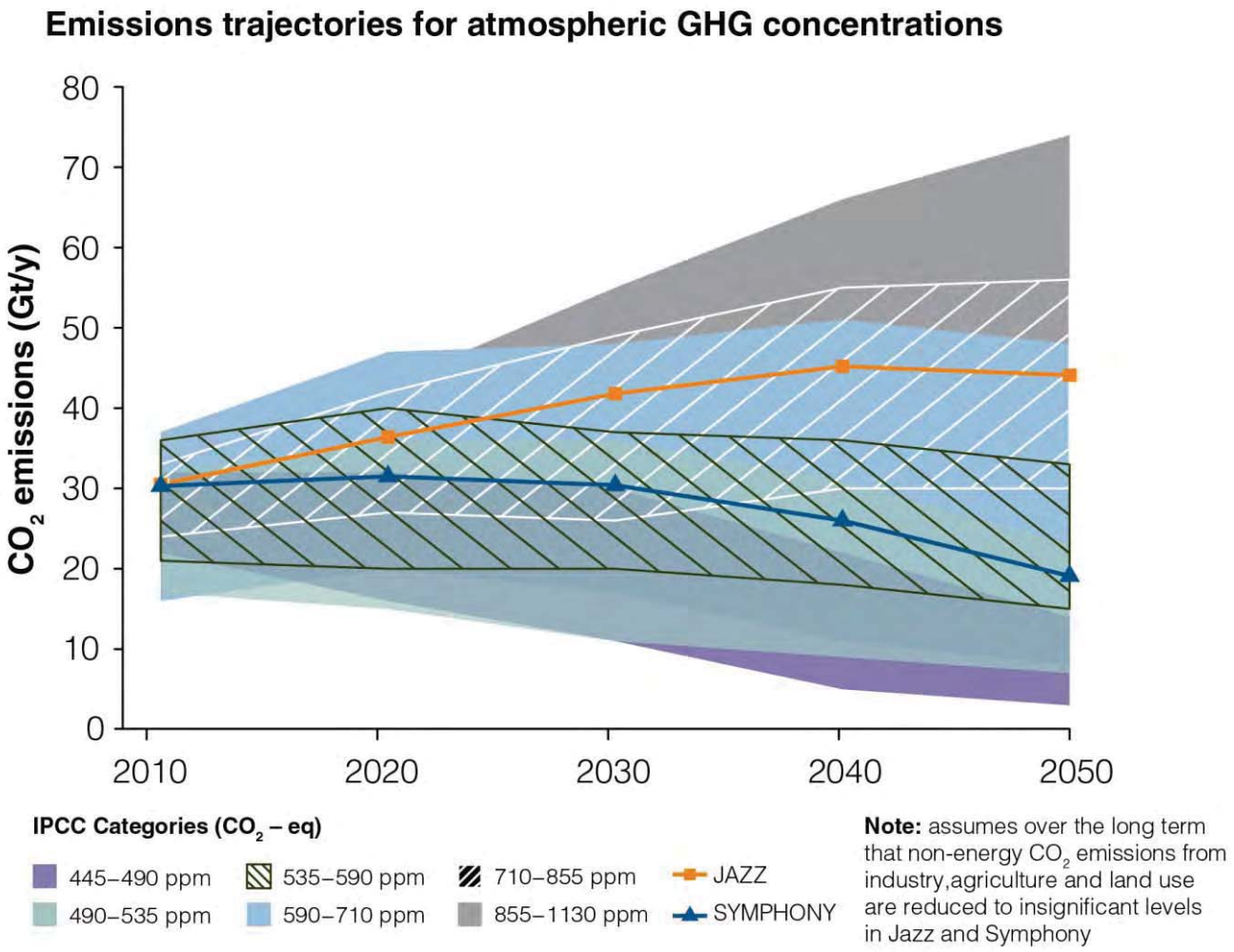
- Legal constraints / mineral rights: in the US, who owns the land, owns what is underneath, which is an important entrepreneurial incentive

Mineral rights are a key issue that enabled US success; critical opportunity to define strong framework; critically important to get clarity of objectives (overall economic growth?) **[!!]**

- Fiscal incentives and access to cheap capital: were there in the US

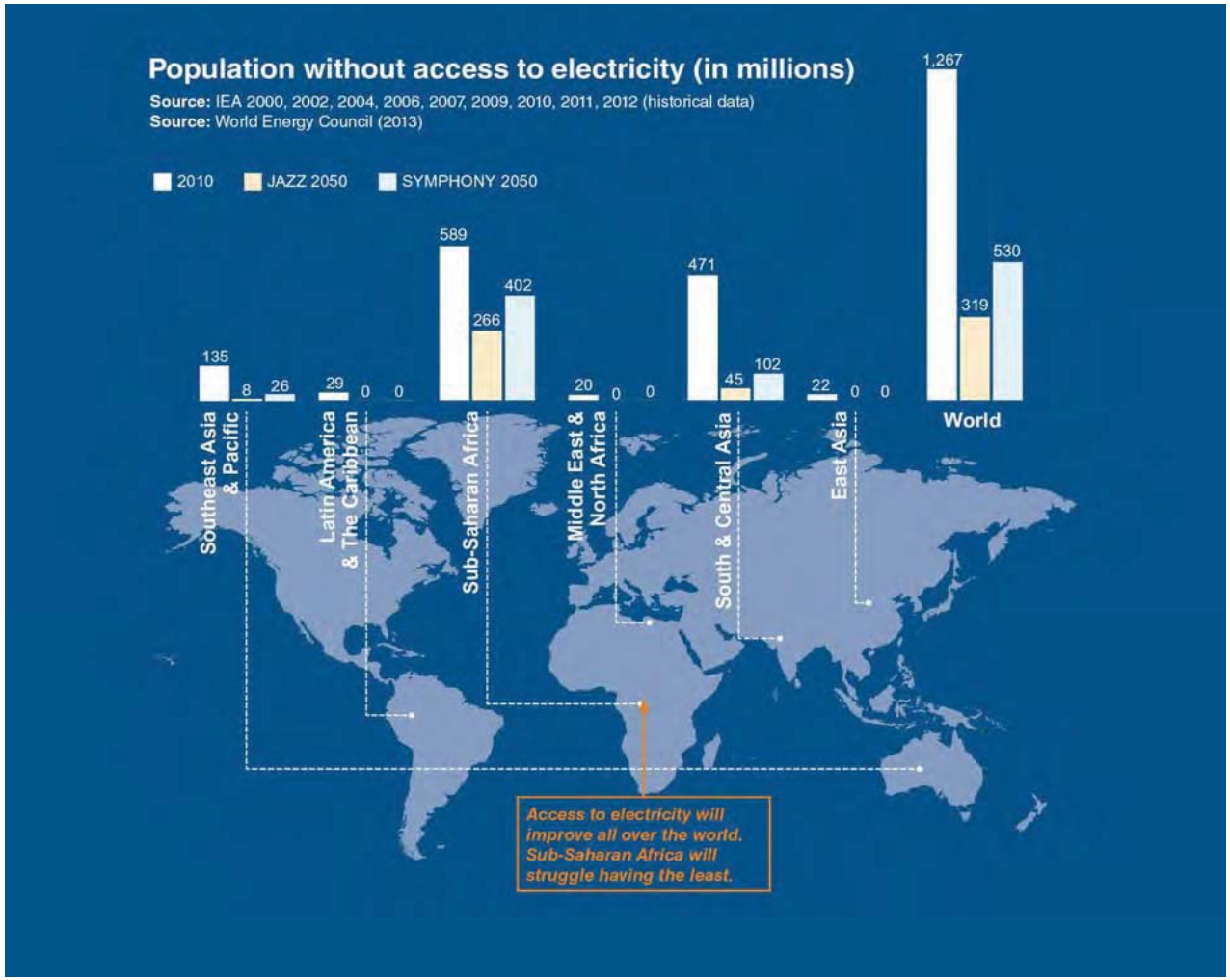
Ensure consistent framework that enables very capital intensive industry **[!!]**

Resulting CO_2 emissions



The global economy will be challenged to meet the 450 ppm target without enormous economic costs

Access to electricity in 2050



JAZZ:

- 310 million without access in 2050

SYMPHONY:

- 530 million without access in 2050

Balancing the ‘Energy Trilemma’

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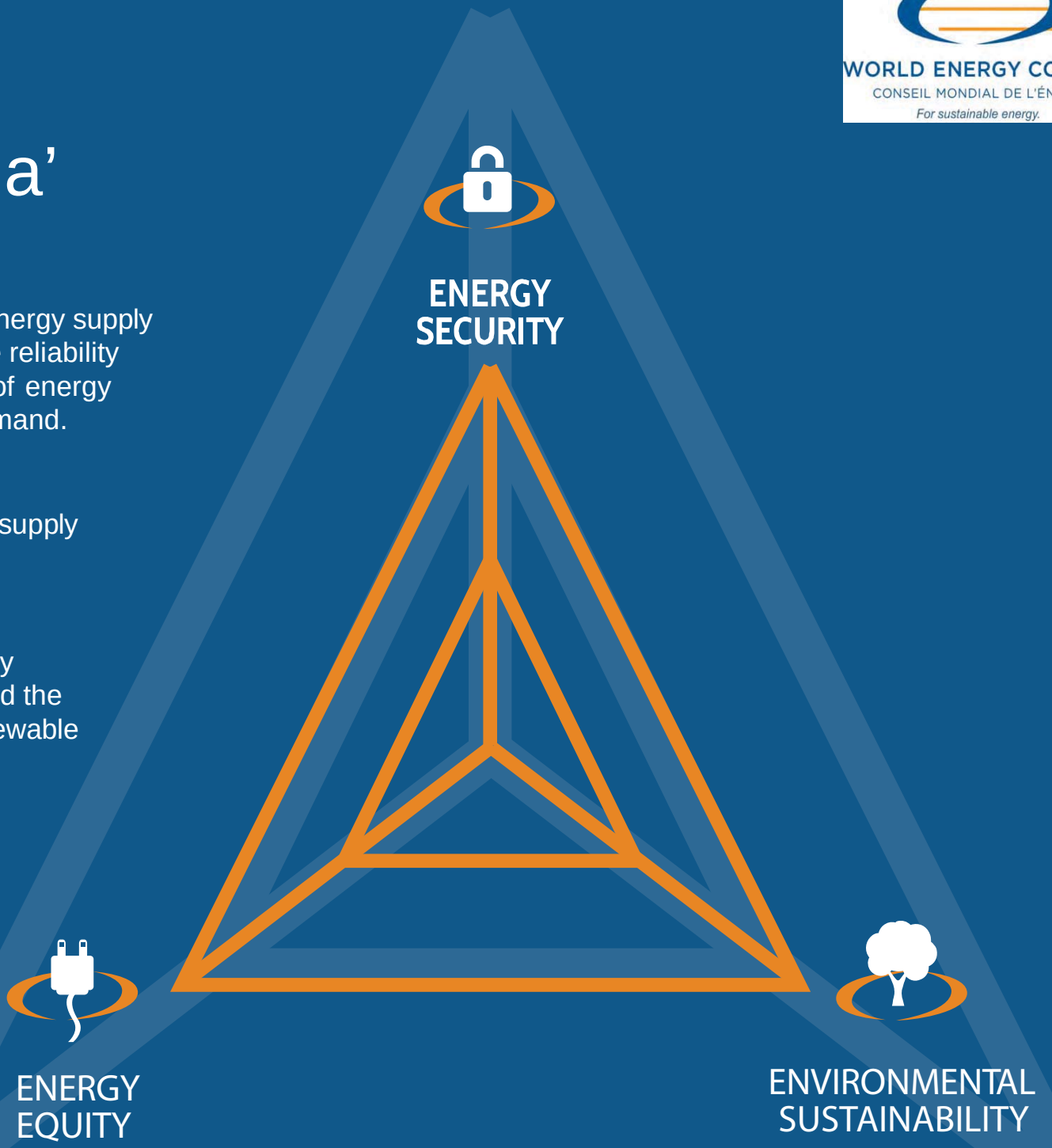
Energy Security
The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.

Energy Equity
Accessibility and affordability of energy supply across the population.

Environmental Sustainability
Encompasses the achievement of supply and demand side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.



5 Top Energy sustainability index

1	Switzerland
2	Denmark
3	Sweden
4	Austria
5	United Kingdom
6	Canada
7	Norway
8	New Zealand
9	Spain
10	France

Top 5 Energy equity

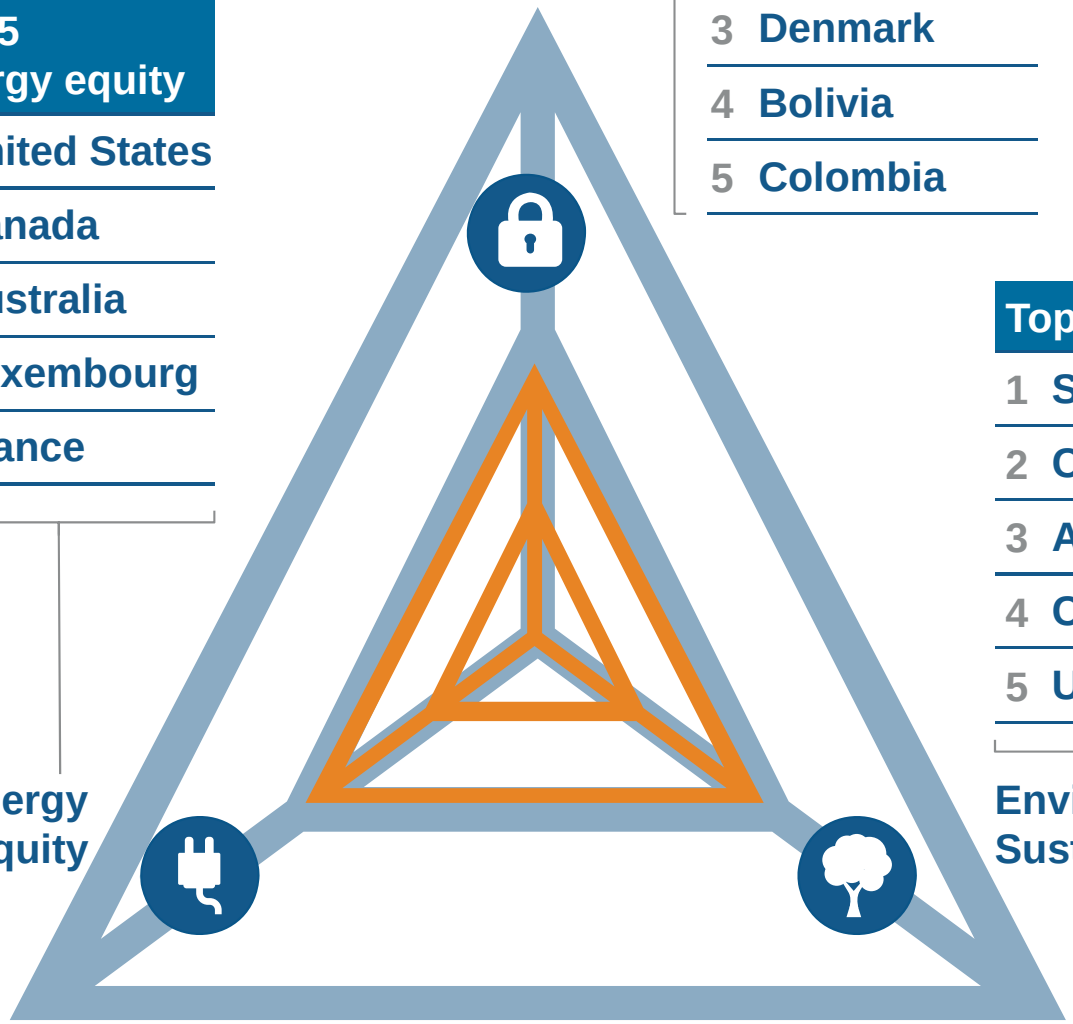
1	United States
2	Canada
3	Australia
4	Luxembourg
5	France

Energy equity

Energy security

Top 5 Energy security

1	Canada
2	Russia
3	Denmark
4	Bolivia
5	Colombia



Top 5

1	Switzerland
2	Costa Rica
3	Albania
4	Colombia
5	Uruguay

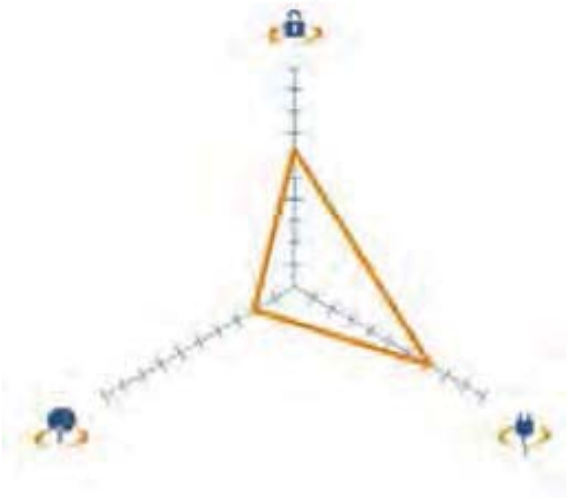
Environmental Sustainability

BALANCE SCORE
BBD

UNITED ARAB EMIRATES

INDEX RANK
44

ENERGY SUSTAINABILITY BALANCE



ENERGY SUSTAINABILITY INDEX RANKINGS AND BALANCE SCORE

	2011	2012	2013	Trend	Score
Energy performance	66	67	62	↑	
Energy security	58	56	49	↑	B
Energy equity	36	39	37	↑	B
Environmental sustainability	106	106	102	↑	D
Contextual performance	26	24	22	↑	
Political strength	36	38	39	↓	
Societal strength	37	33	33	→	
Economic strength	11	13	11	↑	
Overall rank and balance score	**52**	**53**	**44**	↑	**BBD**

22nd World Energy Congress, 2013, Daegu

“The world’s premier energy gathering”

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Summing it all up

22nd World Energy Congress, 2013, Daegu

“The world’s premier energy gathering”

- **7 Myths**
  - **M1: Global energy demand will flatten out. Reality: Energy demand will double by 2050**
  - **M2: Peak Oil. Reality: No shortage for fossil fuels in sight.**
  - **M3: Demand growth will be fully met by new clean energy sources. Reality: The contribution of fossil fuels to the global energy demand is still growing in absolute terms.**
  - **M4: We can reduce global GHG emission by 50% by 2050. Reality: Even in the best case we will see a near doubling of GHG emissions compared to 1990 levels.**
  - **M5: Current business models and markets are delivering. Reality: Current designs are unable to cope with the increasing renewable shares, decentralised systems, or growing information architecture.**
  - **M6: Current programmes will deliver universal energy access by 2030. Reality: On current paths, 320..530 million people will still be without electricity in 2050.**
  - **M7: On a global scale capital is cheap and abundant. Reality: Capital is extremely sensitive to perceived political and regulatory risks. Lack of agreement between investors and governments on nature, price, and value of risks related to energy infrastructure makes capital flow elsewhere.**

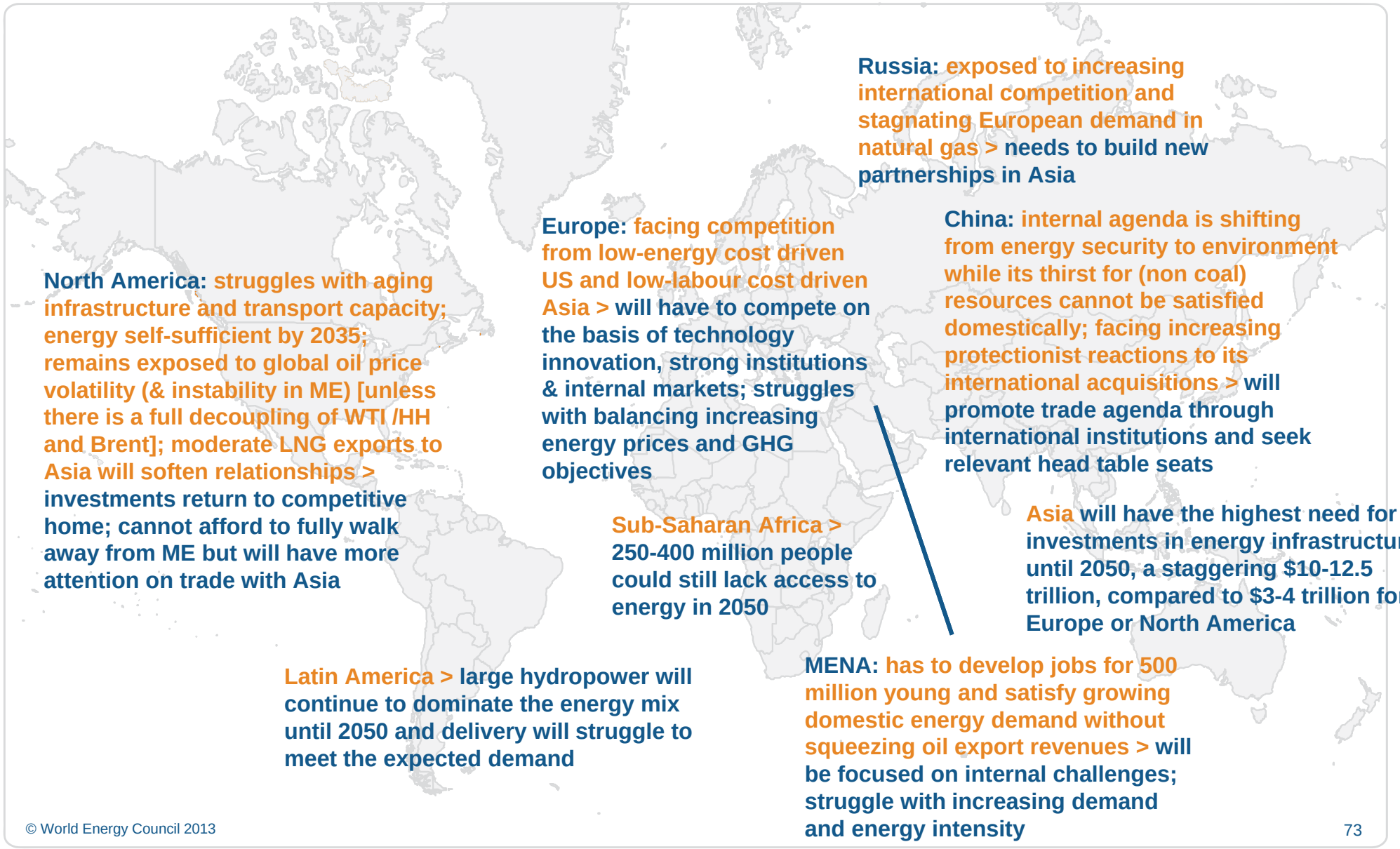
22nd World Energy Congress, 2013, Daegu

"The world's premier energy gathering"

"It is not difficult to come up with a plausible scenarios that fundamentally changes / challenges the conditions under which utilities have to operate in the next decade."

- **7 key Business Implications**
  - **B1: coal & climate > future of fossil fuel is bright, but uncertainty is nowhere greater than in coal > from cheap coal to uncertain coal**
  - **B2: game changer shale gas > from monopoly to competition > from upstream to technology (LNG/micro, biogas, power-to-gas/chemicals, e-storage)**
  - **B3: no space, no capital, no political security, no public acceptance > big is past > from centralized to decentralized > from big plants to scalable small units, big data & smart system integration, re-use of existing infrastructure**
  - **B4: prosumers emancipation & supply competition > from (business unusual) blocker to enabler > from operational excellence to service brilliance**
  - **B5: institutions fail, markets fail, business models fail, financing models fail > BAU is not an option**
  - **B6: saturated traditional markets & growth markets with very different needs > from regional/global brand to local trust**
  - **B7: new risks from extreme weather, EWF-Nexus, cyber > from mitigation to adaptation & from hard to soft resilience**

5 key Regional & Geopolitical Implications



North America: struggles with aging infrastructure and transport capacity; energy self-sufficient by 2035; remains exposed to global oil price volatility (& instability in ME) [unless there is a full decoupling of WTI /HH and Brent]; moderate LNG exports to Asia will soften relationships > investments return to competitive home; cannot afford to fully walk away from ME but will have more attention on trade with Asia

Europe: facing competition from low-energy cost driven US and low-labour cost driven Asia > will have to compete on the basis of technology innovation, strong institutions & internal markets; struggles with balancing increasing energy prices and GHG objectives

Russia: exposed to increasing international competition and stagnating European demand in natural gas > needs to build new partnerships in Asia

China: internal agenda is shifting from energy security to environment while its thirst for (non coal) resources cannot be satisfied domestically; facing increasing protectionist reactions to its international acquisitions > will promote trade agenda through international institutions and seek relevant head table seats

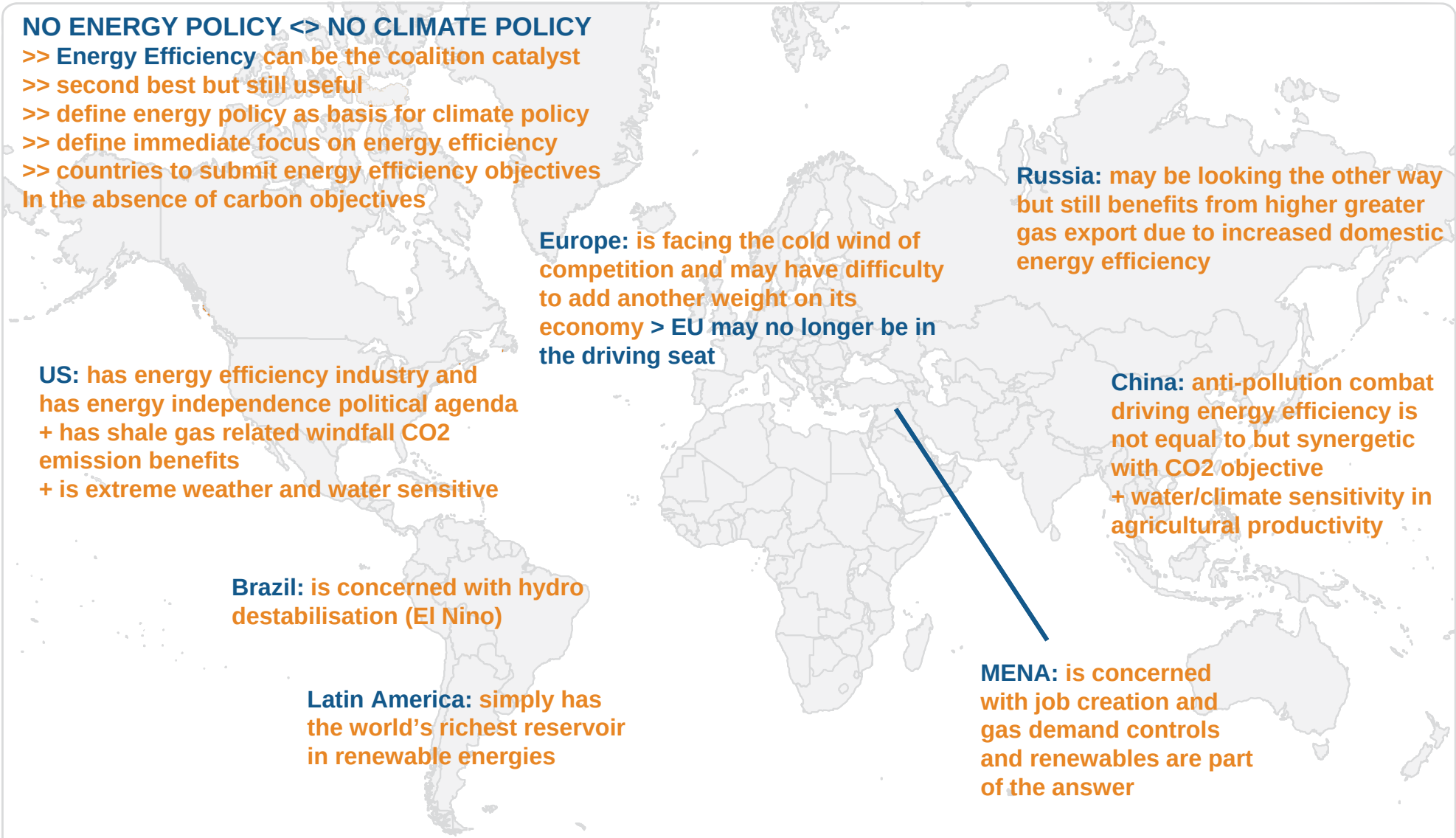
Sub-Saharan Africa > 250-400 million people could still lack access to energy in 2050

Asia will have the highest need for investments in energy infrastructure until 2050, a staggering $10-12.5 trillion, compared to $3-4 trillion for Europe or North America

Latin America > large hydropower will continue to dominate the energy mix until 2050 and delivery will struggle to meet the expected demand

MENA: has to develop jobs for 500 million young and satisfy growing domestic energy demand without squeezing oil export revenues > will be focused on internal challenges; struggle with increasing demand and energy intensity

COP21 2015 in Paris may be successful if focused on energy efficiency



NO ENERGY POLICY <> NO CLIMATE POLICY
>> Energy Efficiency can be the coalition catalyst
>> second best but still useful
>> define energy policy as basis for climate policy
>> define immediate focus on energy efficiency
>> countries to submit energy efficiency objectives
In the absence of carbon objectives

Europe: is facing the cold wind of competition and may have difficulty to add another weight on its economy > EU may no longer be in the driving seat

Russia: may be looking the other way but still benefits from higher greater gas export due to increased domestic energy efficiency

US: has energy efficiency industry and has energy independence political agenda
+ has shale gas related windfall CO2 emission benefits
+ is extreme weather and water sensitive

China: anti-pollution combat driving energy efficiency is not equal to but synergetic with CO2 objective
+ water/climate sensitivity in agricultural productivity

Brazil: is concerned with hydro destabilisation (El Nino)

Latin America: simply has the world's richest reservoir in renewable energies

MENA: is concerned with job creation and gas demand controls and renewables are part of the answer