



Global Energy Today and Tomorrow : Demand, Resources & Technologies

Elena Virkkala Nekhaev, Director of Programmes,
World Energy Council

Promoting the sustainable supply and use of energy for the greatest benefit of all

World Energy Council

1923

Experts from around the world met in London to discuss rebuilding of the power grid after World War I. The first World Power Conference.

2008

A global, non-profit multi-energy organisation covering all types of energy, with Member Committees in 95 countries.

A voice of the energy industry representing the collective wisdom of energy leaders and experts around the world.

World Energy Council: Mission and Objectives

Promoting the sustainable supply and use of energy for the greatest benefit of all

A strong commitment to creating a sustainable energy future according to the **3 A's**:

- **Accessibility** – access to affordable modern energy for all people.
- **Availability** – reliability & security of energy supply.
- **Acceptability** – preserving the environment without compromising future welfare.

Proposed 4th A: **Accountability**

2008-2010 Global Studies

1. Assessment of Energy Policies Best Practises
2. The 22nd Survey of Energy Resources
3. Energy for Mega Cities
4. Rules of Energy Trade and Investment

Technical Programmes and Task Forces

1. Performance of Generating Plant
2. Energy Efficiency Policies and Indicators
3. Cleaner Fossil Fuels Systems
4. Interconnectivity Task Force
5. Biofuels Standards and Technologies Task Force
6. Centres of Excellence for Sustainable Energy

World Energy Congress

A triennial event bringing together key players from all levels, all sectors and all areas of the world

Rome 2007- The 20th World Energy Congress

Over 4000 delegates from 120 countries

201 Speakers: 81 CEO's and 29 Ministers

200 journalists/day, 1100 articles

Exhibition: 300 exhibitors and 35.000 visitors

Montreal 2010 - The 21st World Energy Congress

The Global Outlook

- Global Energy demand up by >50% by 2050 (China & India will account for more than 40% of the increase)
- The use of fossil fuels will increase in absolute terms
- Global CO₂ emissions will rise by 57% (nearly 60% of the global CO₂ emissions will come from China and India)
- EU's total emissions reductions between 2006-2020 will correspond to 70% of China's & India's ANNUAL emissions in 2020

WEC Survey of Energy Resources 2007

www.worldenergy.org

- **Finite Resources:**
 - Coal, Crude Oil, Oil sands, Extra-Heavy Oil, Oil shale, Natural Gas, Uranium, Thorium
- **Intermediate Resources:**
 - Peat, Geothermal
- **Perpetual Resources**
 - Hydro, Bioenergy, Solar, Wind, Marine (Tide, Wave, OTEC)

Coal

- Plentiful (R/P ~200 years)
- Economically recoverable in over 70 countries
- Largest US, Russia, China, Australia, India
- Global total down by 7% in 3 years (refined assessments)
- Demand expected to continue growing
- Strongest growth in developing countries
- Coal-to-liquids for transportation provides additional demand

Oil

- Proved recoverable reserves are 117 billion barrels higher than in 2002
- 61% in Middle East, 11% in Africa, 8% in each of Europe and South America and 5% in North America
- Oil will not run out for many years (R/P ~40 years)
- Predictions of the production peak highly dependent on resource estimate revisions, further discoveries, technology advances, unconventional sources
- Timing is less important than vision of the long-term decline

Natural Gas

- Proved reserves up by 3.5% (2002-2005)
- Approximately half in OPEC (compare oil with 75%)
- 20% in one field between Qatar and Iran
- R/P ~ 56 years from just proved reserves – resources will add more
- Amount to be discovered has been consistently underestimated

Uranium

- Reasonably assured resources grew by 4% (2003-2005)
- 10-fold price increase since 2000
- Largest production in Canada, Australia, Kazakhstan, Russia
- 435 reactors with 367 GW_e capacity at beginning 2007

Nuclear Energy

- 439 nuclear power plants around the world (371GW)
- 31 reactor units under construction (23.4GW)
- Output 2,661TWh in 2007
- France 78%, Lithuania 72%, Slovakia 57%, Belgium 54%, Sweden 48%, Ukraine 47%

Renewable Energy

- **Renewables** provide about 18% of power generation (hydropower ~87% of the total)
- **Bioenergy** – largest share is wood, followed by charcoal and biomass for electricity. Also crop residues, municipal waste etc.
- **Biofuels** – “hot topic”; ethanol : 40% of world production in US and 37% in Brazil
- **Wind** - has grown rapidly, capacity doubling every 3.5 years
- **Solar thermal** - PV and Passive Solar have great potential: PV markets growing by 35% p.a.
- **Marine** energies yet to be fully developed – wave resource alone estimated to be as much as 10TW

Electricity production in 2006

	World (~18.500 TWh)	Europe 25 (~3.200 TWh)
Coal	~39%	~32%
Gas	~17%	~21%
Hydro	~17%	~10%
Nuclear	~15%	~30%
Oil products	~7%	~4%
Wind	~0,7%	~2,5%
PV	~0,03%	~0,1%
Others	~4%	~0,5%

Annual Capacity Additions

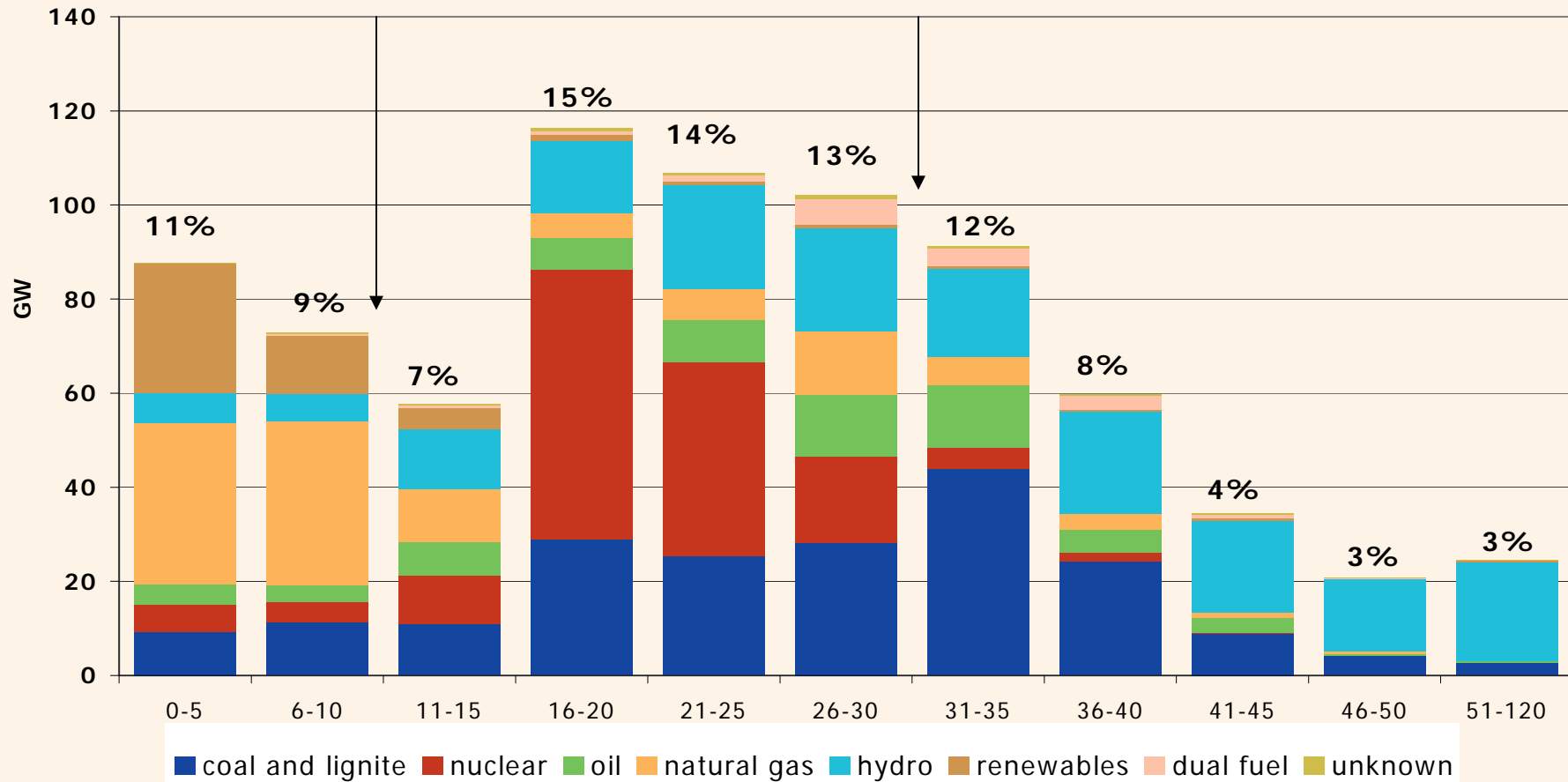
2013-2030

Technology	Number of Additions	Capacity (each)
Coal -fired CCS	22 Coal CCS plants	800 MW
Gas-fired CCS	20 Gas CCS plants	500 MW
Nuclear	20 Reactors	1,000 MW
Hydropower	2 x Three Gorges Dams	18 ,000 MW
Biomass and waste	400 CHP plants	40 MW
Wind	17,000 wind turbines	3 MW

The Age Factor in Europe

in 2020 80% >30 years

Today 30% > 30 years



Costs

(new plants with present technologies at the end-2007)

	Capital Inv. (€/kW)	Hours of utilization (kWh/kW x year)	kWh cost*	
			capital €/MWh x year	fuel costs €/MWh
Natural gas CCP	600-800	(4500-6500)	35-50	56
Coal PC	1000-1800	(5000-7500)	40-60	26
Nuclear	2000- 3000	(7600-8000)	25-50	6
Hydro	1000-2000	(2000-5000)	30-65	-
Wind	1000-2800	(1800-2100)	50-120	-
Solar PV	5000-9000	(1000-1400)	300-700	-

World's Top CO₂ Emitters

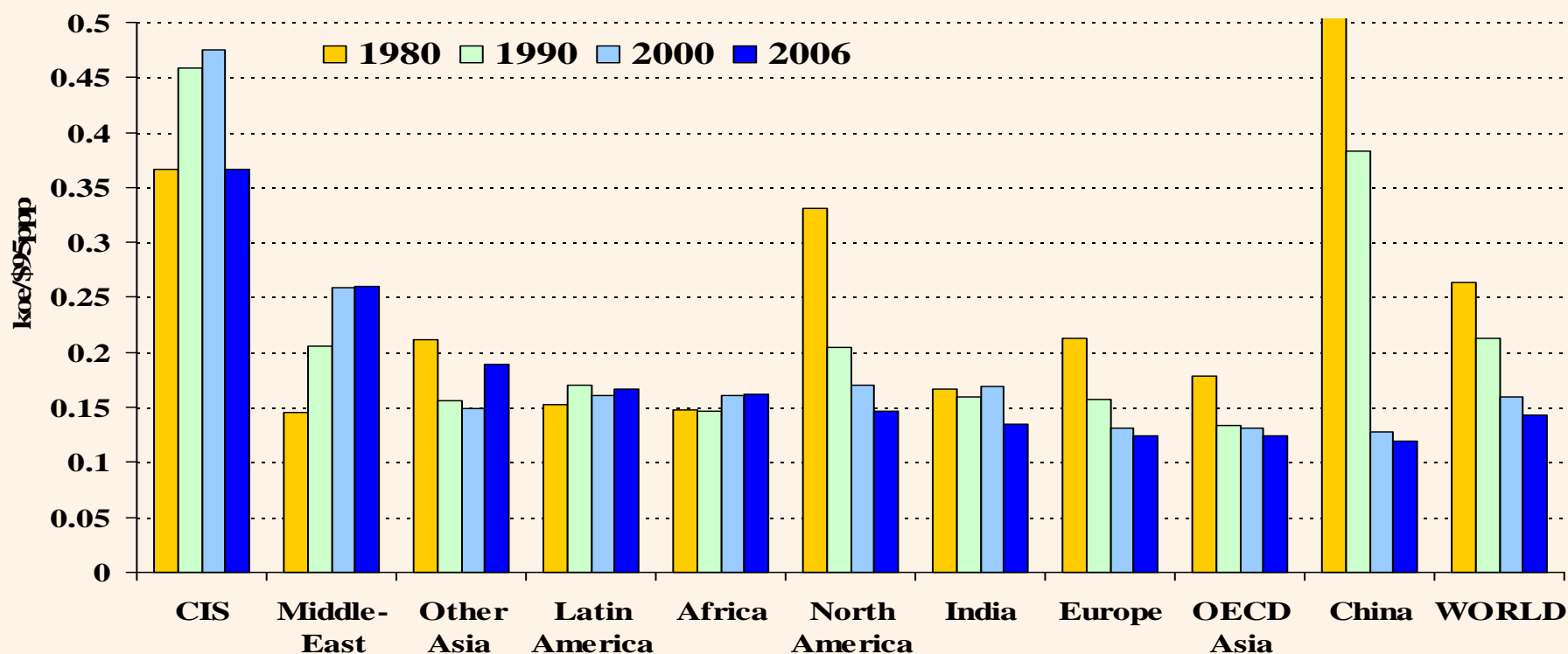
	2005		2015		2030	
	Gt	Rank	Gt	Rank	Gt	Rank
USA	5.8	1	6.4	2	6.9	2
China	5.1	2	8.6	1	11.4	1
Russia	1.5	3	1.8	4	2.0	4
Japan	1.2	4	1.3	5	1.2	5
India	1.1	5	1.8	3	3.3	3

Sectoral shares of CO₂ emissions

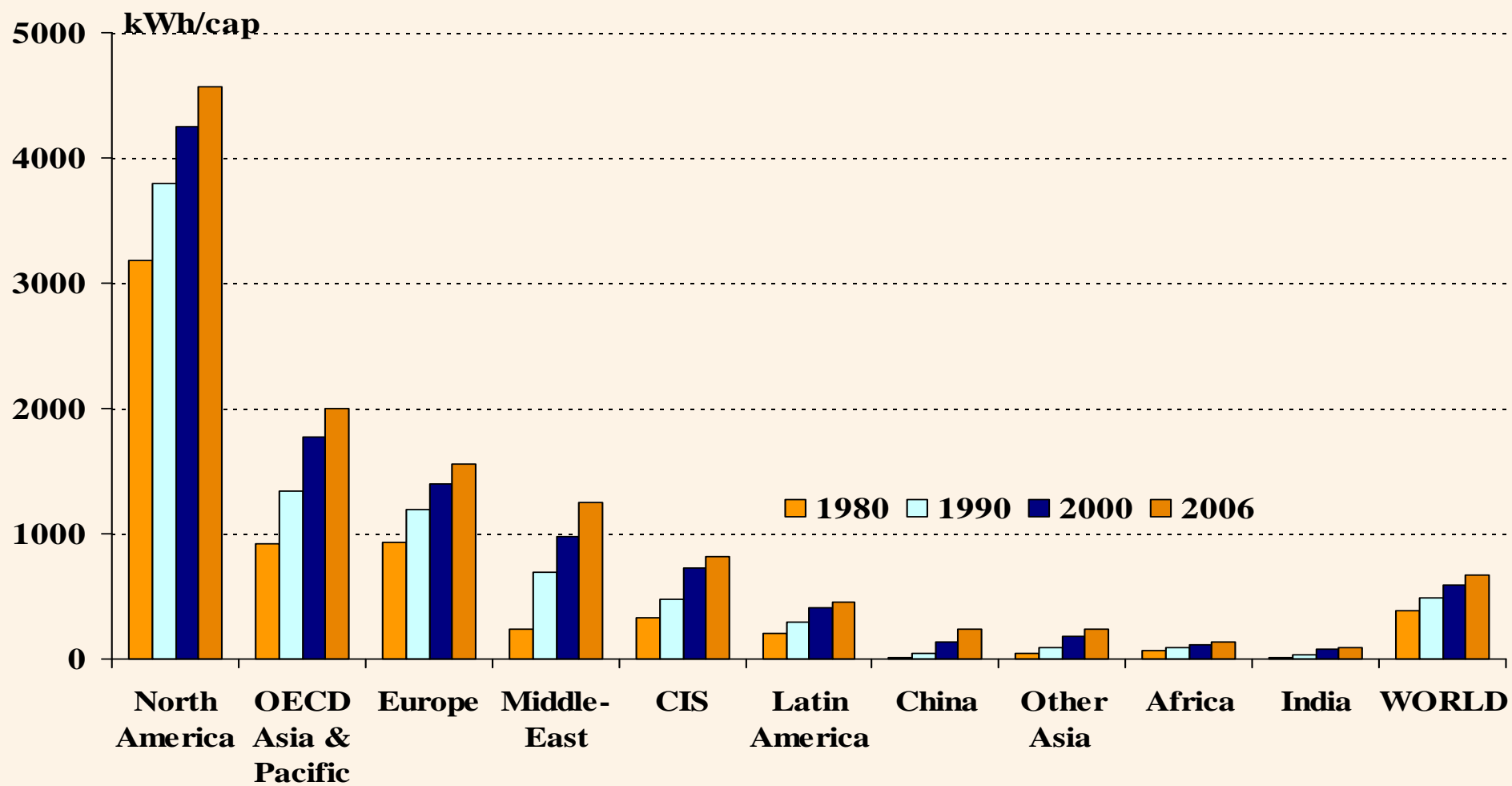
- **Electricity:** 41% -- Largest emitter, but provides greatest reduction potential
- **Transport:** 21% -- Both land and air growing strongly. Key challenge for emissions reduction
- **Industry:** 18% -- Fast growth in developing countries offset by increasing efficiencies everywhere
- **Buildings:** 13% -- Steady growth. Wide variations in emissions intensity.

Convergence of Energy Intensity in Industry due to Globalisation

Energy intensity of industry



Household Electricity Consumption per capita



Annual Household Heat Consumption in Latvia

Heat consumption (kWh/m ² per year) in percentage of the total number of the analyzed houses		
Less than 200	200 - 250	More than 250
5%	65%	30%

Development of Household Heat Consumption in Finland

Year	1970	1975	1980	1985	1990	1996
kWh/m ³	72	65	57	52	50	45
kWh/m ²	216	195	171	156	150	135

The “Forgotten Asset”

- Worldwide the existing carbon-based power plants should be an integral part of any sustainable production strategy:
 - Limitations of alternative energy sources must be recognised
 - No solution for substantial reduction of demand/intensity
- The challenge is to reduce the carbon footprint by improving environmental performance, efficiency and reliability
 - Retire/replace existing coal plants with “clean coal” plants
 - Improve emissions levels at the existing plants

Existing Power Plants – The Forgotten Asset

Plant Performance Improvement:

- Emissions reductions
- Fuel/Cost savings

Value of Performance Improvement:

- Economic: US\$80 billion per year
- Environmental: 1Gt of CO₂ reduction per year & proportional reductions of other emissions

Relative Benefits of the Options

New Generation Facilities

CO₂ mitigation benefits = combined value of efficiency impact + CO₂ capture rate

- Large impact at the plant level
- Lower impact at national level due to a small share of new facilities in the overall generation mix

Existing Generation Facilities

CO₂ mitigation benefits = CO₂ scrubbing and/or performance improvements

- Can be relatively modest at the plant level
- Large number of plants at national level provides an excellent opportunity value

Sustainable Energy Technology Portfolio

• Efficiency	• Renewables
• Clean Coal	• Carbon Capture & Storage
• Combined Heat & Power	• Distributed Power
• Smart Electronic Control	• Nuclear Power

Current Energy Policies

- Lack of global thinking: local or national priorities
- Full life cycle assessment not used
- Inadequate to the scale of the issue
- Ineffective and short-sighted
- Confusing and unfocused

Key Messages

- To meet the energy needs of all the people in the world, global energy supplies will have to double before 2050.
- The world has sufficient energy resources, knowledge, skills and capital to meet the supply needs; the challenge is to get them from where they are plentiful to where they are needed most.
- Universal access to energy can be achieved without economic, social or environmental penalties.

Key Messages

- Higher energy prices will drive efficiency and attract capital investment in developed countries but robust international cooperation and integration is necessary to avoid unintended negative consequences exacerbating energy poverty in developing countries.

Private sector engagement is essential – influencing national policies, developing and implementing delivery strategies and ensuring focus on realistic and sustainable solutions.

WEC Policy Recommendations

- Keep all energy options open
- Promote energy efficiency, both in supply and end-use
- Raise public awareness of the important role of energy and its applications, transport sector in particular
- Introduce a global price for carbon
- Closer integration of energy markets, regionally and globally
- Establish a new international framework for technology transfer
- Establish consistent and long-term tax, regulatory, legal and commercial frameworks

Thank you!

nekhaev@worldenergy.org