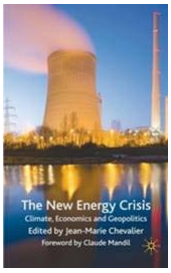
The New Energy Crisis: Climate, Economics, and Geopolitics



Jean-Marie CHEVALIER

With 3 co-authors: Patrice GEOFFRON, Sophie MERITET & Pierre ZALESKI

Octobre 2009 1

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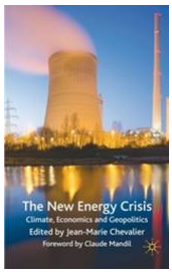
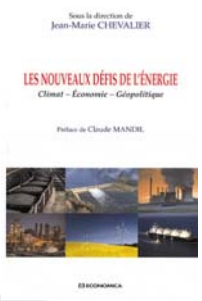


- **"The New energy Crisis: Climate, Economics and Geopolitics" (Palgrave, 2009)**
- **"Les nouveaux défis de l'énergie: climat, énergie, géopolitique" (Economica, 2009)**
- **Edited by Jean-Marie CHEVALIER**
- **Foreword by Claude MANDIL**



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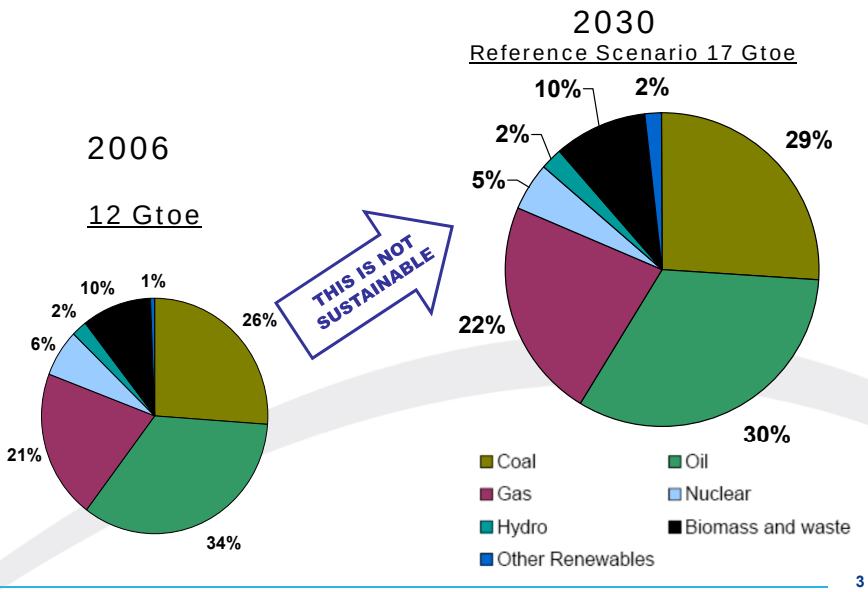
CGEMP – The new Energy Crisis AUP - October 2009

World Energy Balance



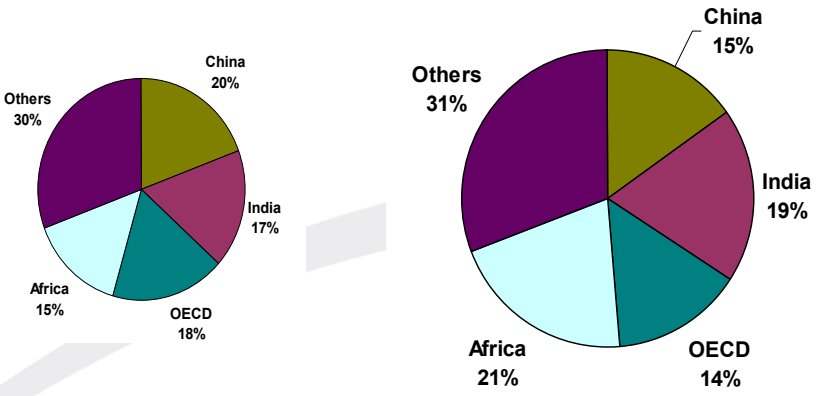
Source: World Energy Outlook 2008 – IEA

Demographic Shift

2009
6.8 Billion

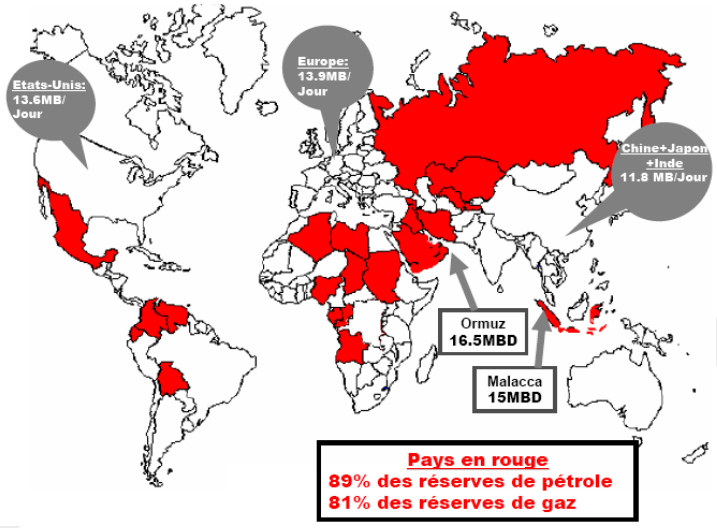
+ 2.6

2050
9. 4 Billion



Source: Population Reference Bureau, 2009

Concentration des réserves sur les pays « à risque »



Source: CGEMP based on data available from BP (2008) and IEA (2008)

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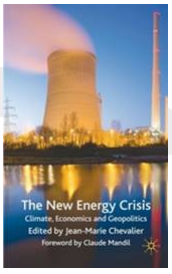

The Message

1. Energy is a global issue and world energy future has to be sustainable
2. Oil price is still the leading energy price
3. A number of elements tend to indicate that energy prices will be much higher than in the past (70 to 80 $/b vs 20 to 30)
4. The building of a single European energy market provides an energy vision of the future.
5. The key strategic principles : energy efficiency - management of the climate change – diversification of energy technologies and sources.
6. A permanent challenge for market intelligence, energy intelligence, catching business and political opportunities.

Conclusion

- **Action**
- **Adaptation**
- **Prices**
- **What did you do today ?**

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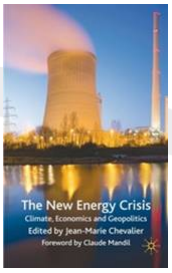
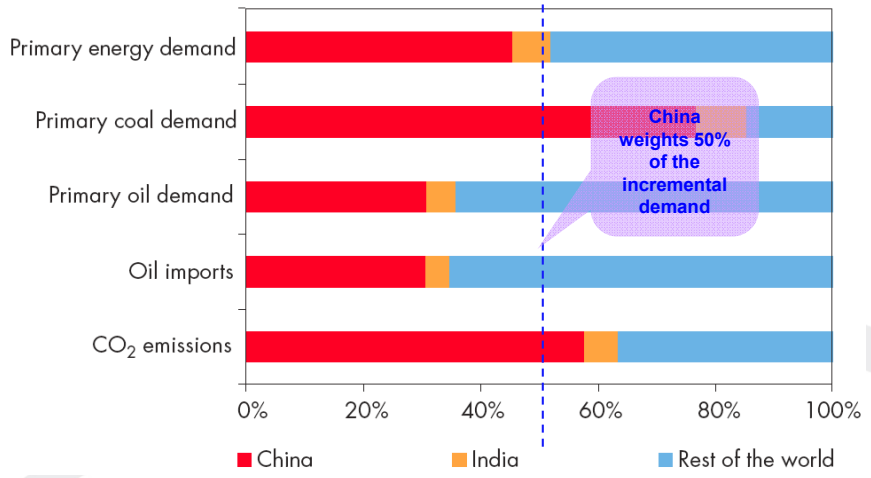


Patrice GEOFFRON

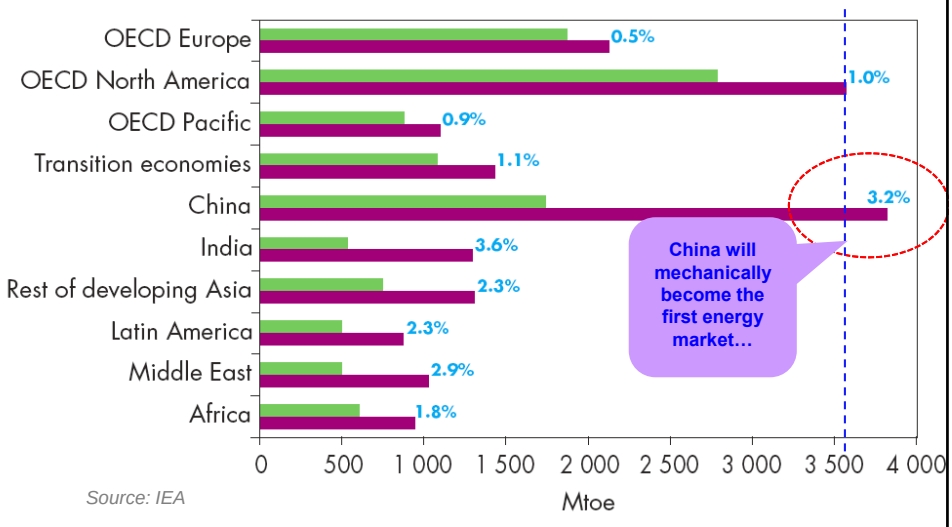
Origin of the energy consumption increase since 2000



Source: IEA

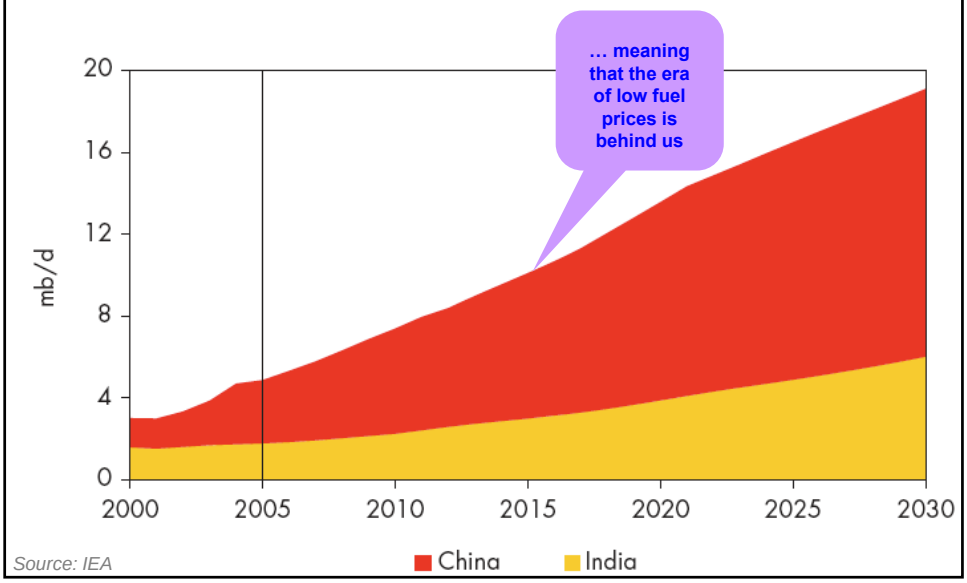
☑ *Newest issues more located on the demand side*

Dynamics of the consumption by Region→2030



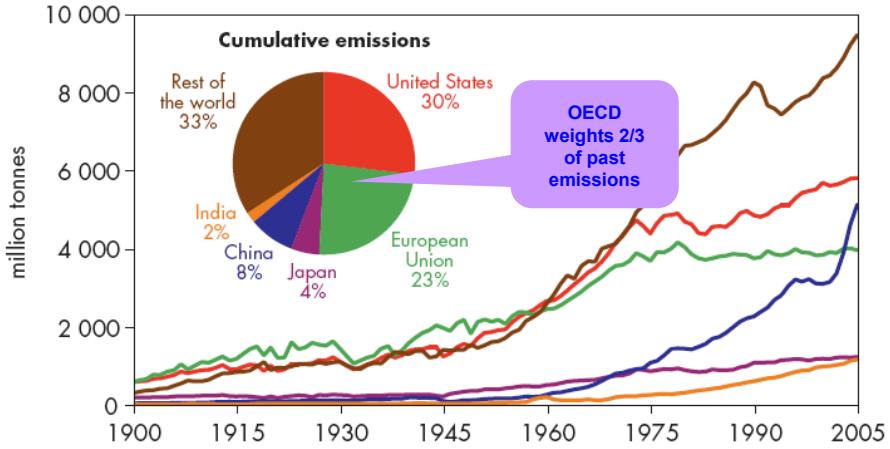
Source: IEA

Net oil imports in China and India



Source: IEA

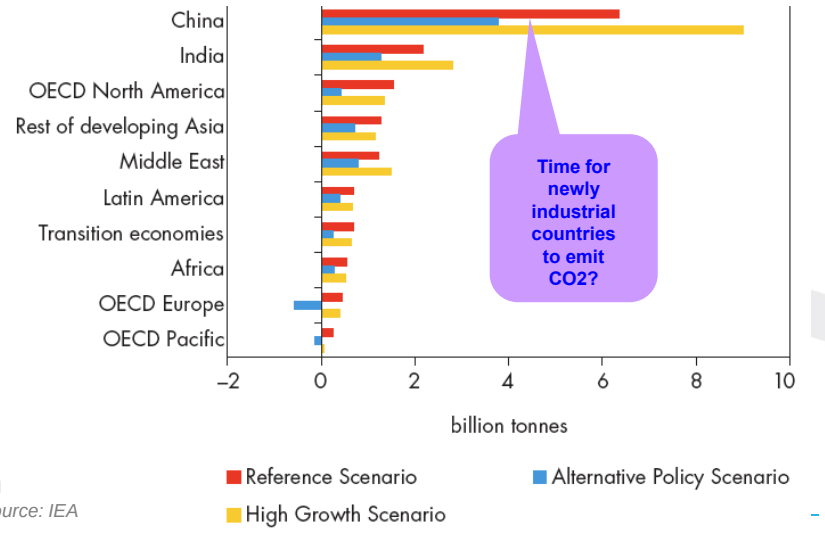
Energy-related CO2 emissions by regions in the past…



Source: IEA

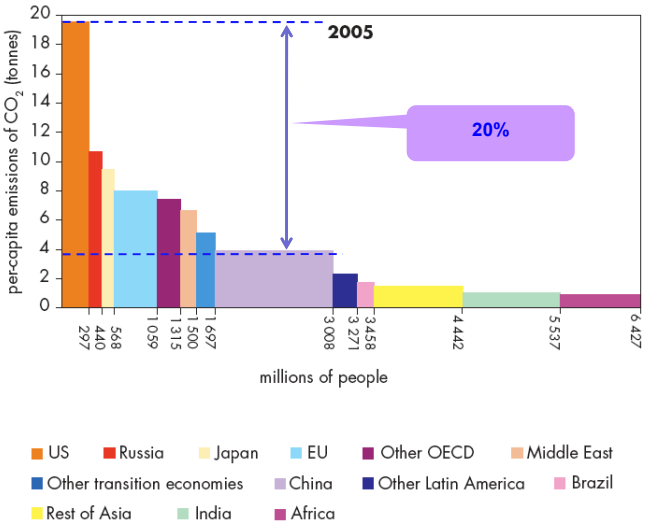
☑ *OECD ± 15% of world population*

… and in the future

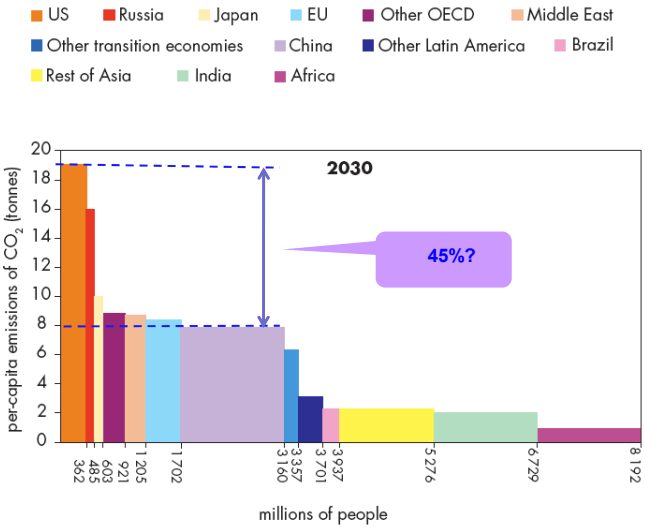


Source: IEA

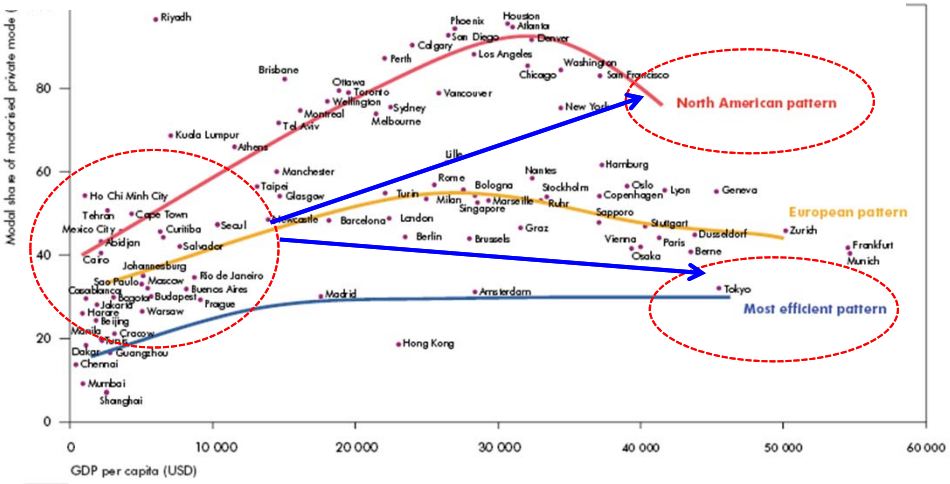
Per-capita related CO2 emissions in 2005



Per-capita related CO2 emissions in 2030



Not only an issue of energy mix, but also of social organisation



Source: IEA

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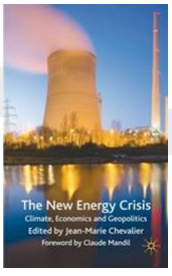
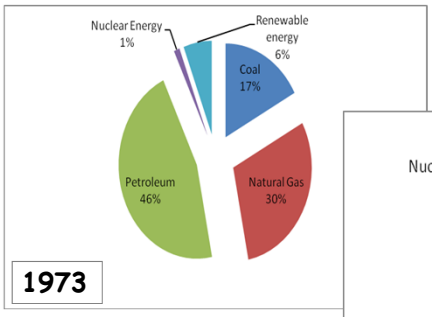
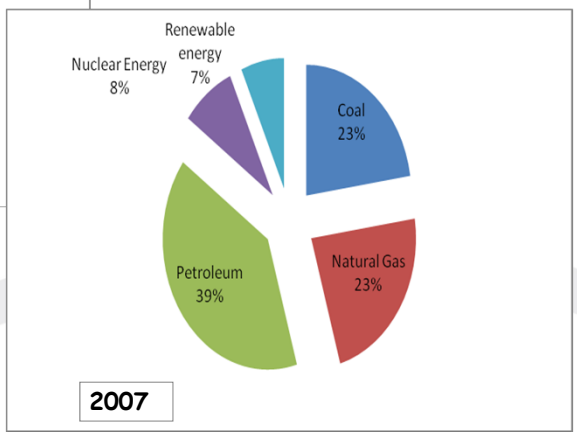


Sophie MERITET

Ch 6: The USA at a Turning Point?



US energy balance 1973-2007



Primary energy consumption by sources in % 1973 (**75 708 364 Bil.Btu) & 2007 (**99 872 921 Bil. Btu**)

Source: BP Statistical Review World Energy , 2008

Ch 6: The USA at a Turning Point?

- **Exceptional development of American capitalism founded upon abundant, cheap and domestic energy resources: coal, oil, natural gas, hydro electricity and nuclear.**
- **A growing dependence on imports for oil and natural gas and a decrease in the domestic productions**
- **Strategic priority => security of SUPPLY**
- **Obvious growing awareness of climate change. In the absence of a federal environmental policy, states are taking some initiatives**
- **Obama (January 2009) "*We will harness the sun and the winds and the soil to fuel our cars and run our factories*"…**

The American energy policy at a turning point….

- Energy - climate change : a challenge and not a constraint !
- Obama (2009) « *America can be the 21st century clean energy leader by harnessing the power of alternative and renewable energy, ending our addiction to foreign oil, addressing the global climate crisis, and creating millions of new jobs that can't be shipped overseas*"
- A green revolution..
- Project Bill : American Clean Energy and Security Act or Climate Change Bill

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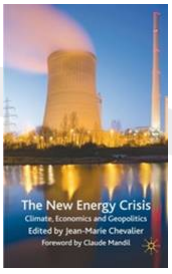

Pierre ZALESKI

Need for new power plants ?

Next few decades 2 - 4

- **Priority to energy conservation and efficiency**
- **BUT**
- **Increase of population**
- **Need for development for large part of world population – ¾**
- **Therefore large consensus that demand of electricity will increase (also replacement of older plants)**

Possible energy sources

- **Fossil – coal gas, oil**
  - ***Dominant – CO2 issue – Finite resources + Geopolitical issue***
- **Hydroelectricity, geothermal**
  - ***Limited resources economically acceptable***
- **New renewable – wind, solar, waves…**
  - ***Very expensive at least for time being***
- **Nuclear**

Criteria for selection

- Industrial feasibility
- Availability of capital (investment)
- Economy
- Security of supply
- Sustainability
- Environmental effects
- Effects on health of population

Cost benefit - analysis

In general and not purely economic sense

- Varies from country to country

Needs, resources, cost of labor, cost of capital, sensitivity to environment and sanitary effects

- We are therefore discussing examples of some important countries

Nuclear renaissance and low carbon economy

- **Large uncertainties**

Present	2030	2050
370 GWe	400-1000 GWe	600-2000-2500 Gwe

1000 GWe – save 8 G tones CO2/year

- **In 2030 differences between BAU and 450 scenarios – 19G tones CO2/year**
  - competitive with coal in many countries - without penalty for CO2
  - competitive with coal in all countries - with some penalty for CO2 (≥ 20 $)

Asia Nuclear Energy Perspectives

Japan	47 GWe		2009
	60 GWe	40%	2017
	90 GWe	60%	2050
	+ 20 GWt		
South Korea	18 GWe		2009
	25 Gwe	45%	2020
		60%	2035
China	9 GWe		2009
	60 GWe	5%	2020
	160 GWe	10%	2030
India	4 GWe		2009
	40 GWe*		2020
	400GWe*		2050

*Including 5 Breeders of 0,5 GWe each *September 2009, declaration of Prime Minister of India

Other countries : Vietnam, Malaysia, Thailand, Indonesia…

ASIA: 300 GWe Estimates of maximum new builds by 2030

Nuclear Energy Perspectives in Russia and USA

Russia	**22 GWe**	**2009**
	52 GWe	**2020**
	230 GWe	**2050**
	industrial development of Breeders	**2025**
	Presently Breeders	
	1 breeder 0,6 GWe	**operating for 25 years**
	1 breeder 0,8 GWe	**in construction**
USA	**100 GWe**	**2009**
	110 GWe	**2020**
	300 GWe*	**2050**

* **MIT and EPRI's perspective**

Russia + USA: 100 Gwe Estimates of maximum new builds by 2030

Uranium resources and production

estimates

- **conventional**
  - including speculative ≈ 16 Millions tonnes
- **unconventional**
  - by product, Phosphate ≈ 22 Millions tonnes
- **extremely expensive**
  - sea water, Granite ≈ 4000 Millions tonnes
- **present production**
  ≈ 40 000 Millions tonnes/year
- **production 2015**
  ≈ 60 000 Millions tonnes/year

Uranium consumption

- **Presently ≈ 70 000 tonnes > 200 years with conventional resources**

If dynamic development of nuclear energy

- **present technology**
  - conventional and unconventional
  - up to 2060 new reactor's constructions
- **with Breeders**
  - few thousand years with already mined uranium
- **with sea water, granite and thorium**
  - factor 100 (additional)

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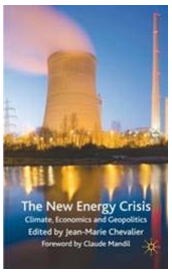

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