

**Les Houches  
Ecole de Physique Seminar  
March 9 2018**

**Finance and Energy**

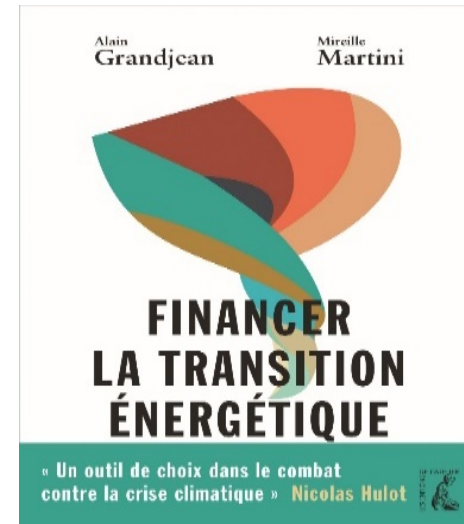
**Mireille Martini**

*The Shift Project, Member of the Expert Committee  
Finance Watch, Research and Advocacy, Sustainable Finance*

# My background

*Commission Présidentielle  
Canfin-Grandjean*

Mobiliser les Financements pour le Climat (Cop 21), Juin 2015



*Commission Stern Stiglitz sur la tarification du carbone au niveau mondial*  
High Level Commission on Carbon Prices , 29 Mai 2017, T20, Berlin



*Research and Advocacy, Sustainable Finance*

# Agenda

## 1. *Strangers in the night*

No finance nor energy in economic modelling

## 2. *High energy also in finance*

Both finance and energy have surged since the 1970s: what is the link?

## 3. *How is energy financed? Project finance*

Off balance sheet financing pushes the debt on foreign countries

## 4. *How is energy financed? Commoditization via derivatives*

The financialization of energy kills the energy price signal in the economy

## 5. *The crown joules*

The end of the gold standard triggered the globalization of finance: it was caused by the US need to drill abroad

## 6. *King of pain*

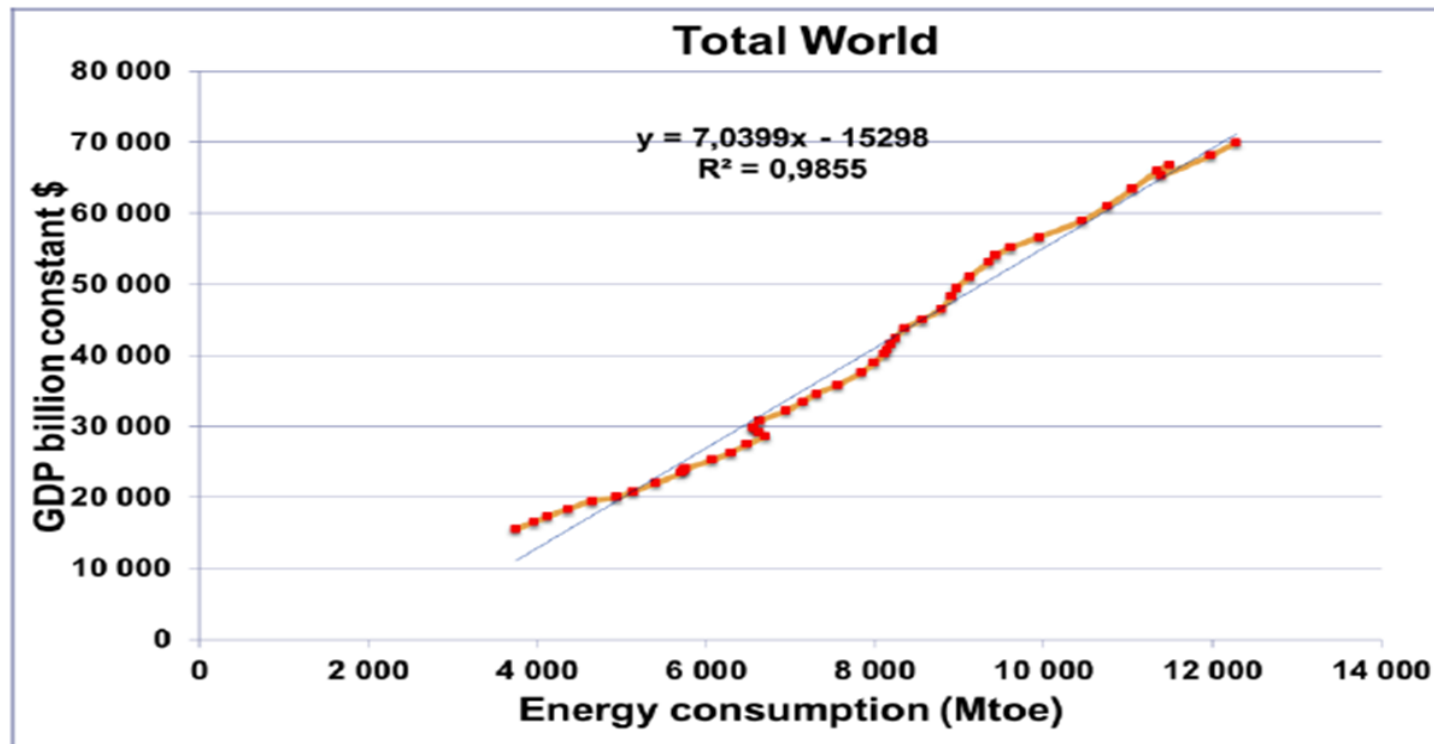
The values of currencies is linked to their access to energy; the transition to a low carbon economy requires a new international monetary order

## 7. *The way out – A call to the scientific community*

# 1. Economics underscores the role of energy

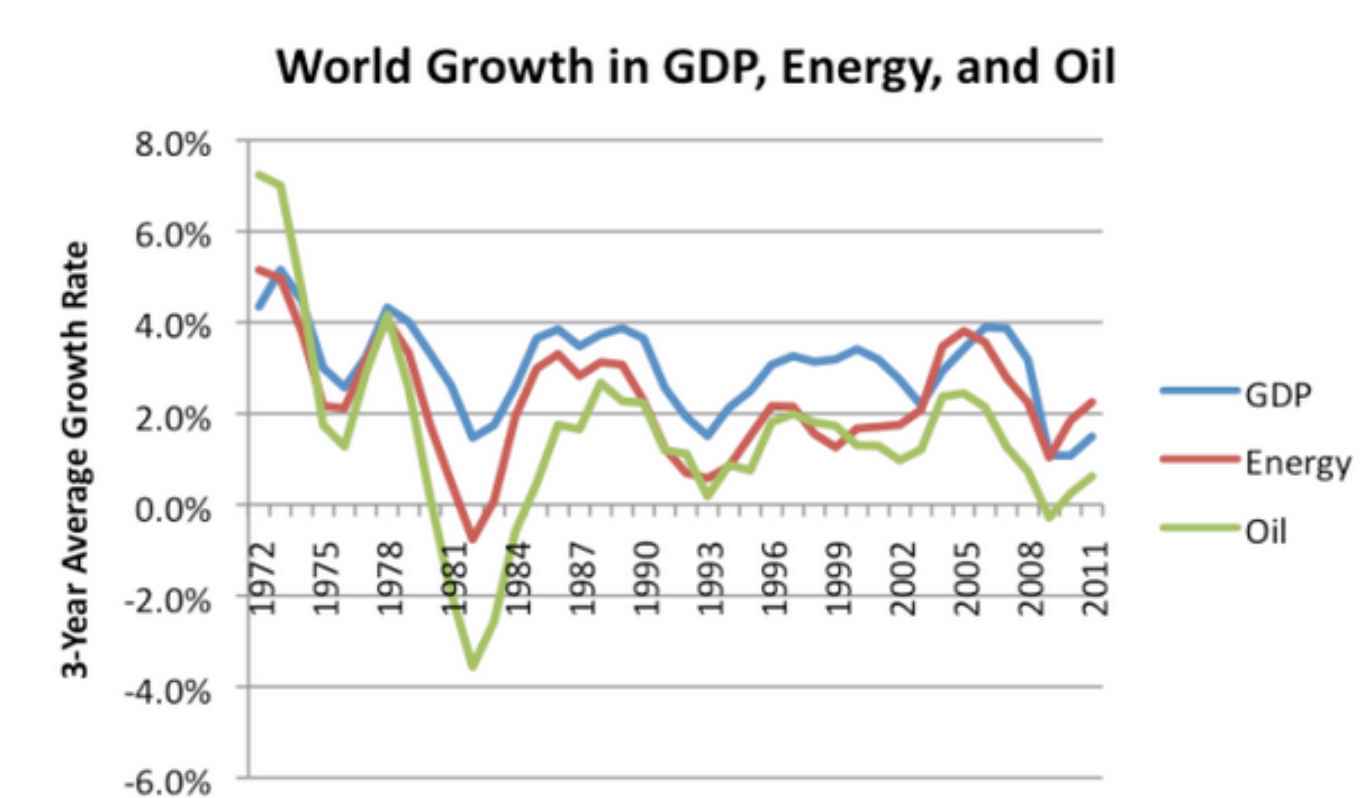
- Theory, economic modelling: Cost share theorem: energy is 8% of GDP (direct share) – energy does not matter
- Reality: The growth of energy consumption explains 60% of GDP growth

Academic reference: <https://www.parisschoolofeconomics.eu/IMG/pdf/article-pse-medde-juin2014-giraud-kahraman.pdf>



Source : BP statistical review, 2012, Shilling et al. 1977, EIA, 2012, et Banque Mondiale (PIB), 2012.

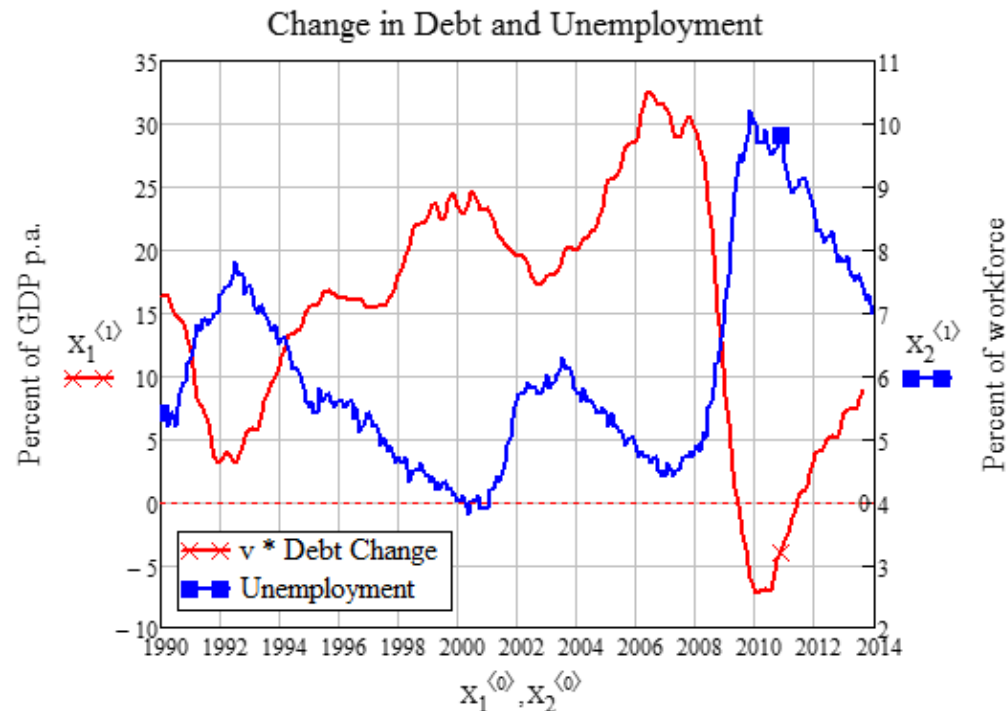
# Closely correlated: growths in GDP/Energy/ Oil



# Economics underscores the role of finance

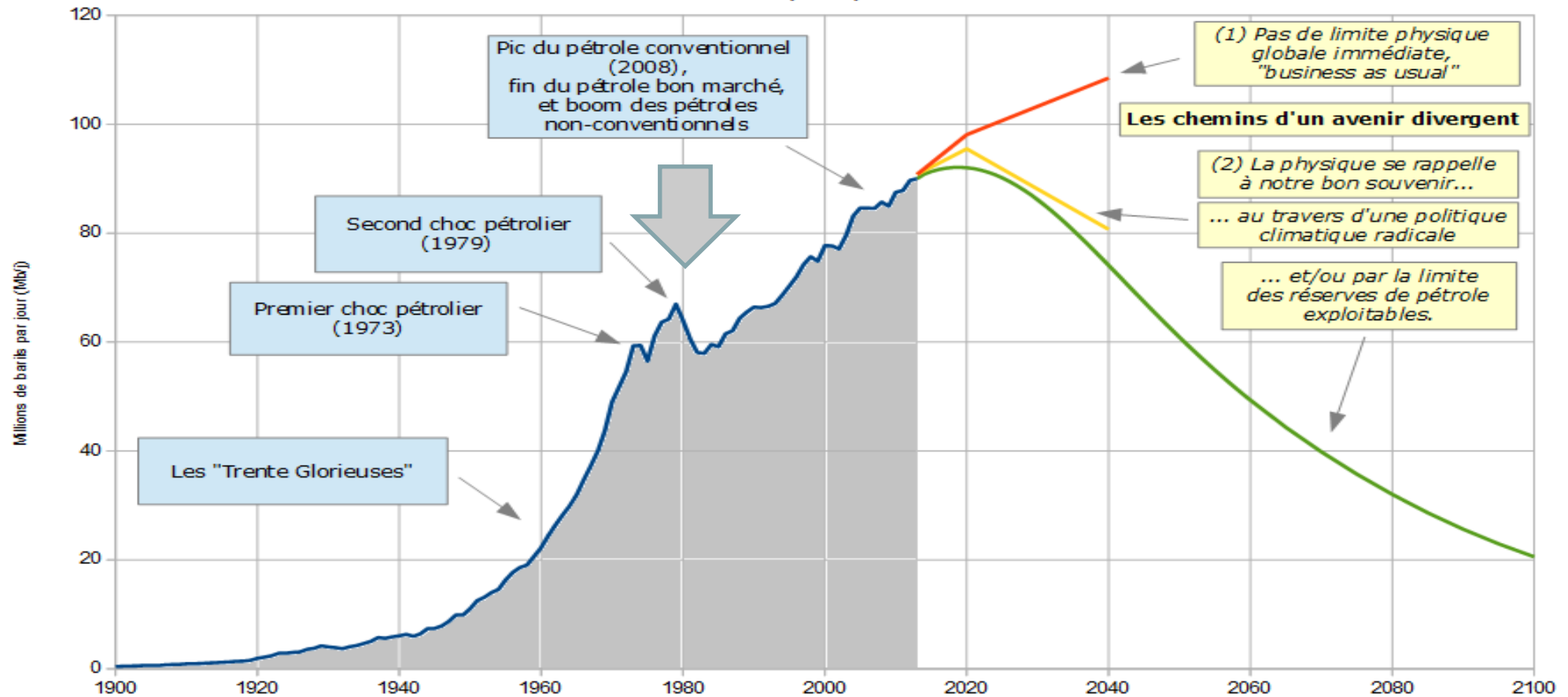
- Theory: economic theory ignores finance
  - No debt: Aggregate debt equals aggregate credit, therefore they cancel each other
  - Money is neutral: JB Say: Money is a simple veil on trade.
  - Money is exogenous, except for a few post Keynesian economists: Steindl, Minsky, Keen (see graph below)
  - Interest on bank loans and changes in financial asset prices are NOT included in GDP.
- Reality:
  - Credit growth and debt deflation have major consequences on the real economy
  - Banks and financial institutions are major players in the real economy, and in society
  - Financial derivatives impact real prices (see below)

A c a d e m i c r e f e r e n c e :  
<http://www.chair-energy-prosperity.org/publications/comparaison-modeles-meteorologiques-climatiques-economiques/>  
 Alain Grandjean et Gaël Girard



## 2. Huge growth in energy consumption over the XXth century....

### Production mondiale de pétrole et substituts Histoire et prospective



— Production historique (1900-2013)

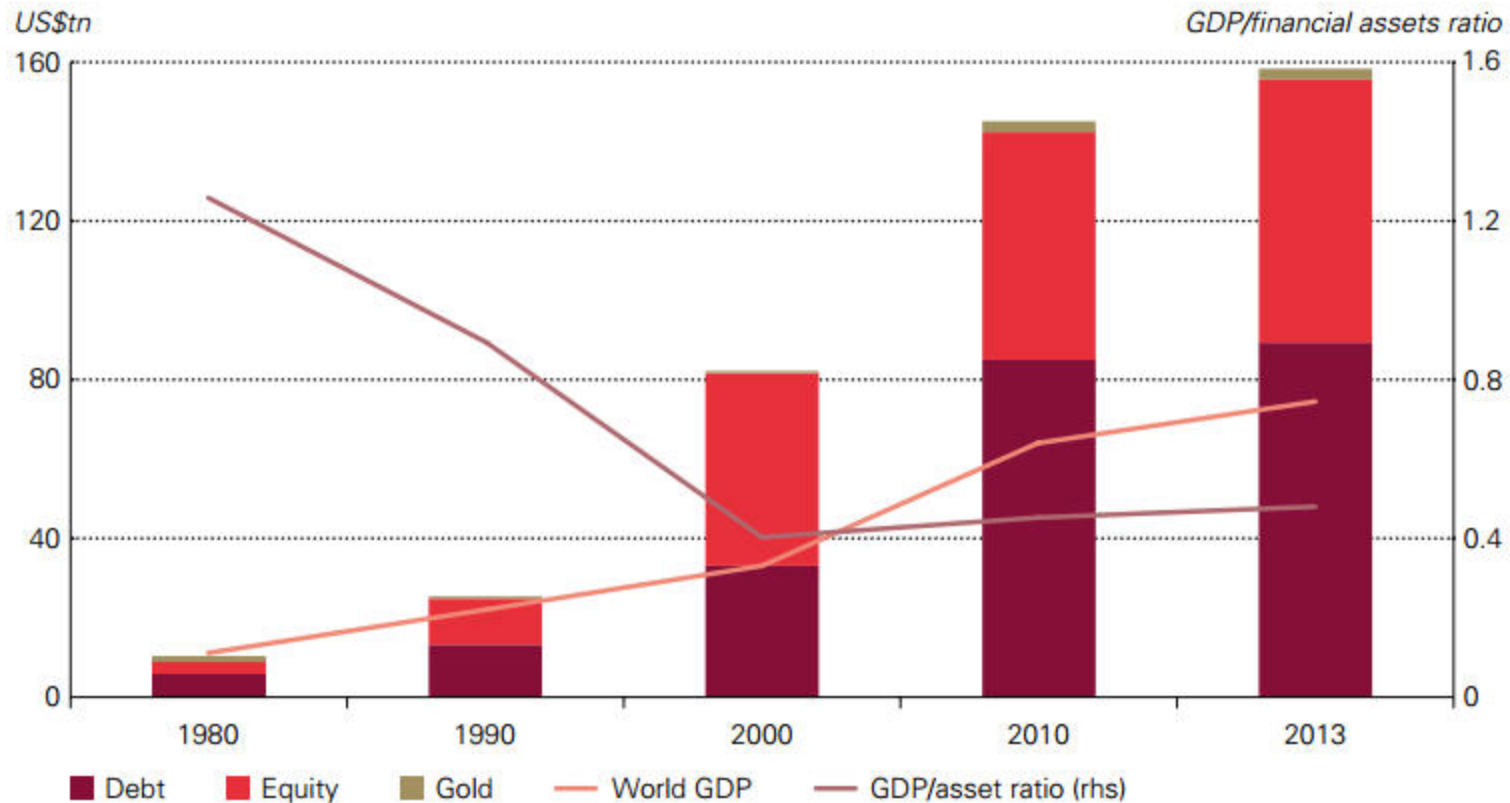
— Agence internationale de l'énergie, 2014. Scénario "New Policies" 2040 : prolongation des tendances actuelles (si possible).

— Agence internationale de l'énergie, 2014. Scénario "450 ppm" 2040, compatible avec un réchauffement du climat inférieur à 2°C en 2100 : l'humanité doit restreindre drastiquement sa consommation de carburant aux alentours de 2020.

— Jean Laherrère, président d'ASPO France, 2014. Scénario fondé sur une hypothèse de ressources pétrolières récupérables ultimes de 3000 milliards de barils. La production mondiale de tous les types de carburants déclinerait à partir de 2019-2020 (pic pétrolier global), faute de ressources exploitables de brut suffisantes. (En 1998, Jean Laherrère a prédit correctement la fin du pétrole pas cher et le pic du pétrole conventionnel intervenu en 2008, voir chapitre 27.)

# And huge growth in financial assets...

**Chart 1: Global financial assets have grown at an unprecedented rate**

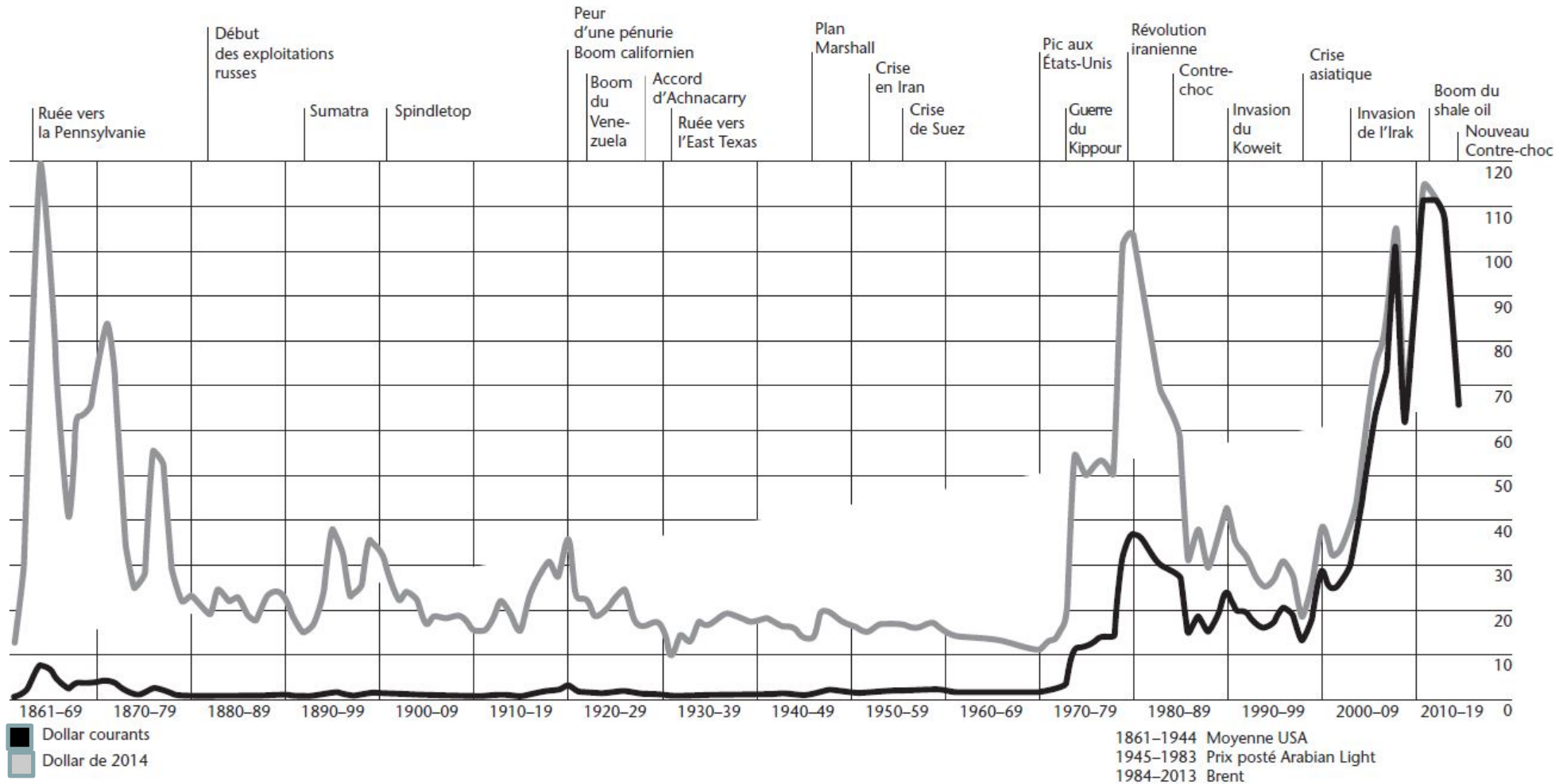


<http://www.mining.com/chart-unprecedented-growth-of-global-financial-assets-24216/>



# The surge in oil prices dates from the 1970s

Prix du pétrole brut (1861-décembre 2014)



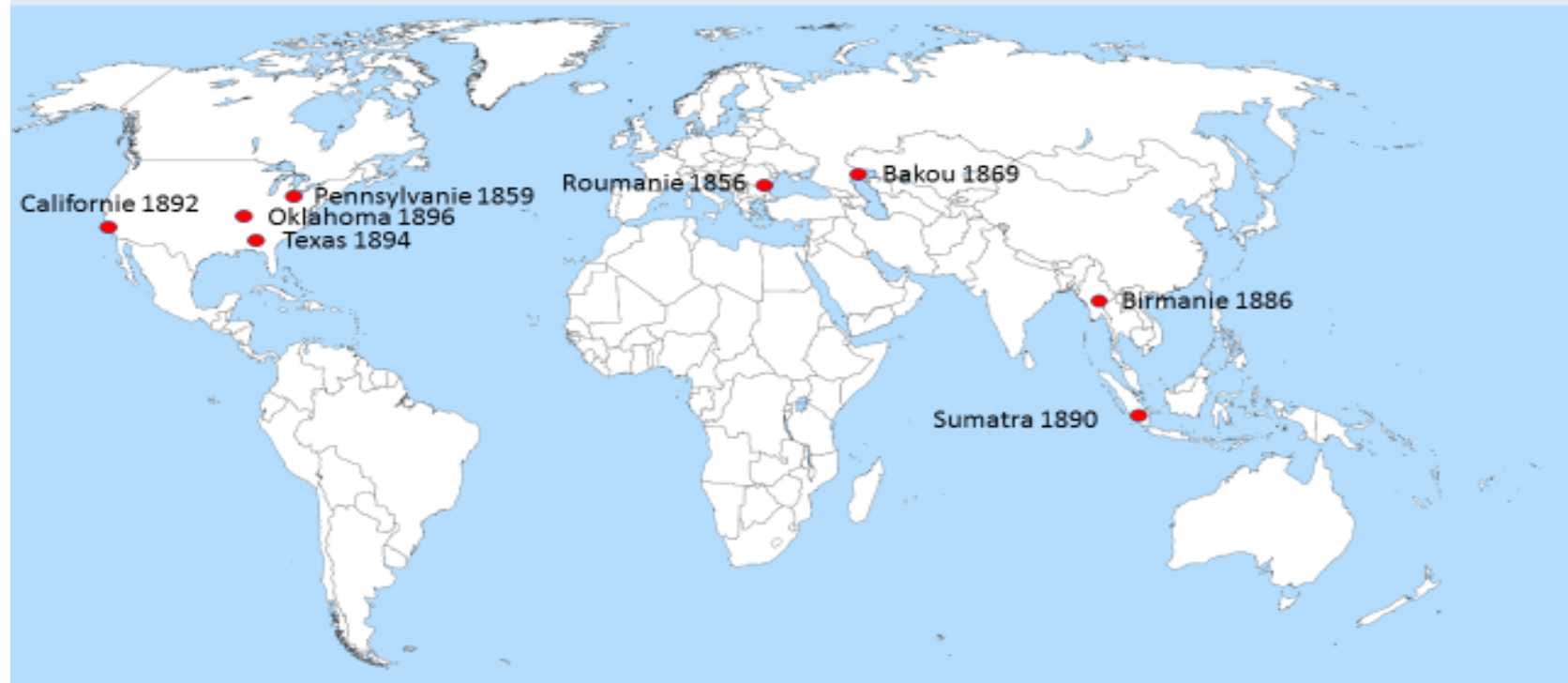
Thanks to Shifter Francis Charpentier

Source : BP, 2014.

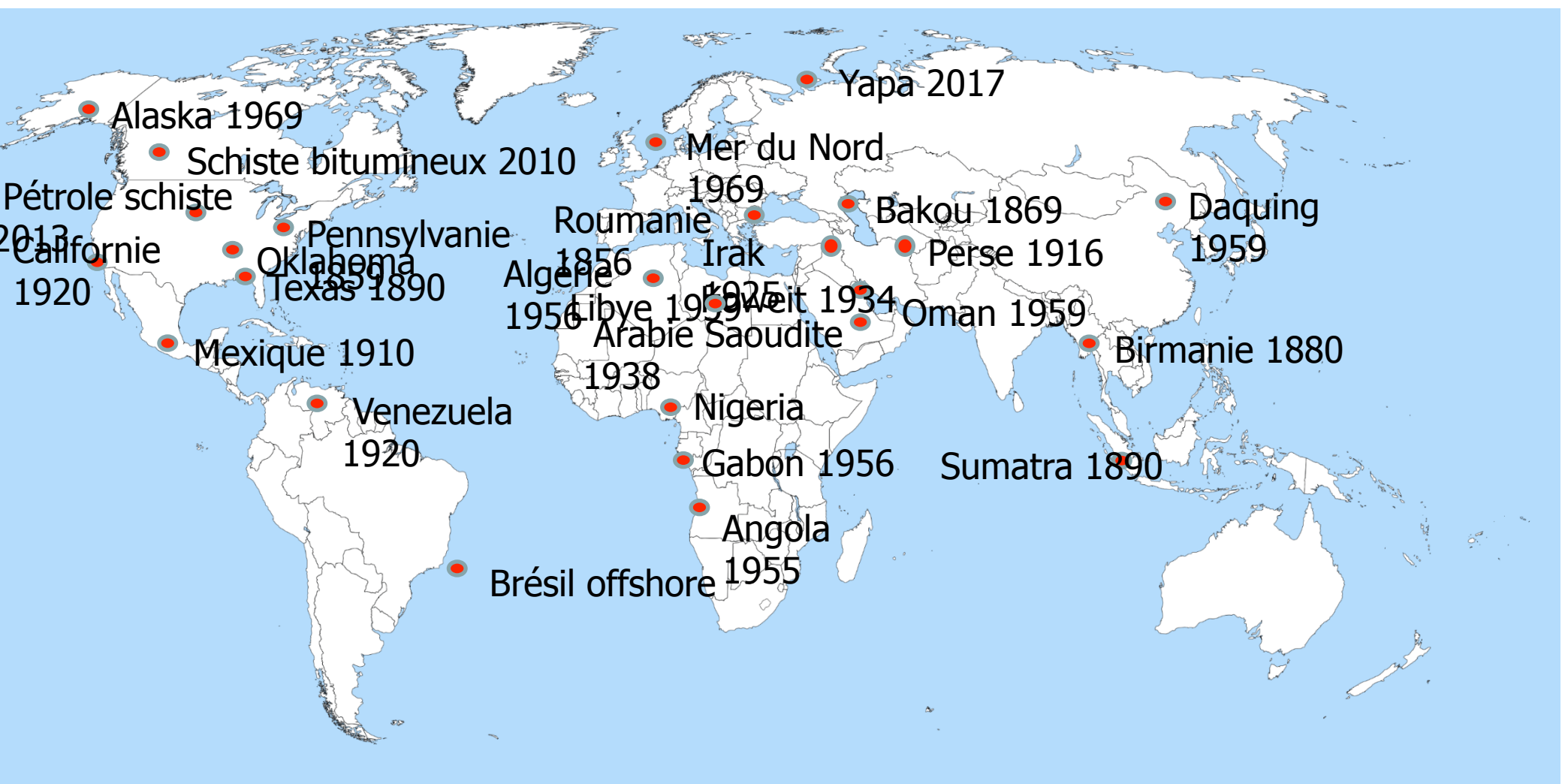
### 3. How is energy financed? Project financing techniques

- Nuclear energy is mostly financed directly from government budgets.
- Fossil fuel energy (oil, coal, gas) is mostly financed using project financing techniques.
- This is because the physical resource mostly lies in high risk countries: the risk of exploration and production needs to be insulated from the balance sheet of the industrial sponsor (the oil major)
- This has major consequences on the links between fossil fuel energy and hard currencies, as we shall see.

#### Gisements de pétrole en 1900



# Main oil fields in 2015



# Example\* : TOTAL's refinery in Nigeria

**Corporate Finance:** The refinery is on TOTAL's balance sheet

**Project Finance:**  
The refinery is a ring-fenced Nigerian company

Assets TOTAL SA Liab.and Eq.

Other assets	Other Liabilities and Equity
Refinery cost 1000 M €	TOTAL SA borrows to finance the refinery 1000 M €

TOTAL SA

Investment cost in SPV 30 M €	TOTAL's resources 30 M €

Total Nigeria (SPV)

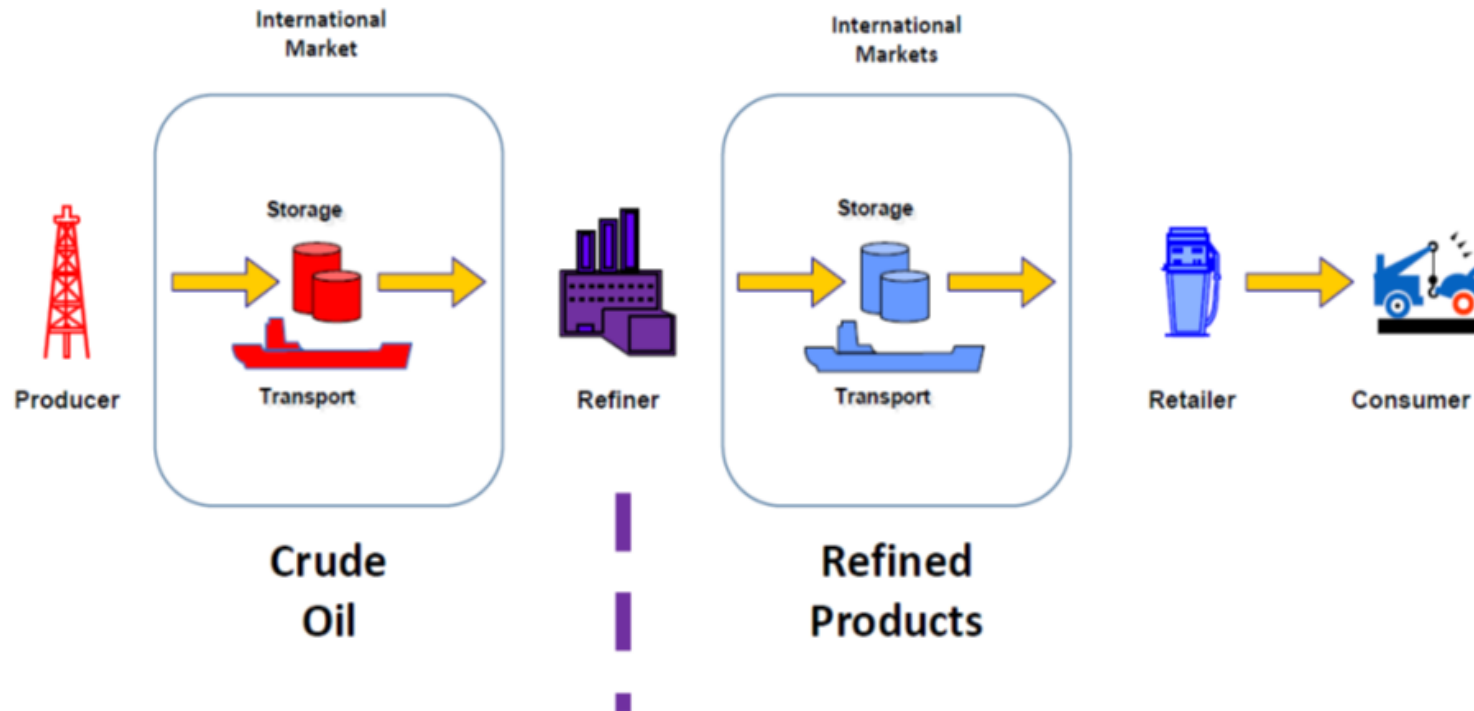
Refinery cost 1000 M €	Equity 200 M € Nigerian State 100 M € TOTAL 30 M € Pension Funds 70 M €
	Borrowing on local or international financial markets 800 M €

\* *Not real*

The SPV must not be consolidated in TOTAL's balance sheet<sup>1,2</sup>— TOTAL needs to own less than 30% equity

## 4. Financial derivatives: a major part of energy financing

Both crude oil and refined oil are commoditized: traded on derivatives financial markets

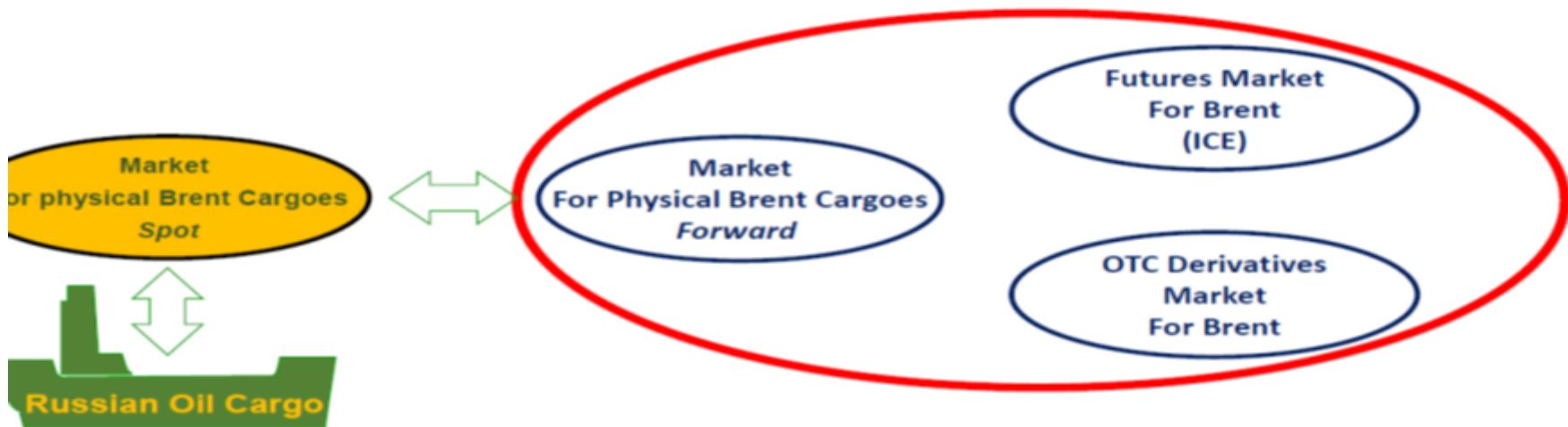


*Thanks to Frédéric Baule*

# The price of physical oil is made by reference to financial derivative products

Markets for Oil Price Benchmarks = Financial Markets

## A market for physical Oil....



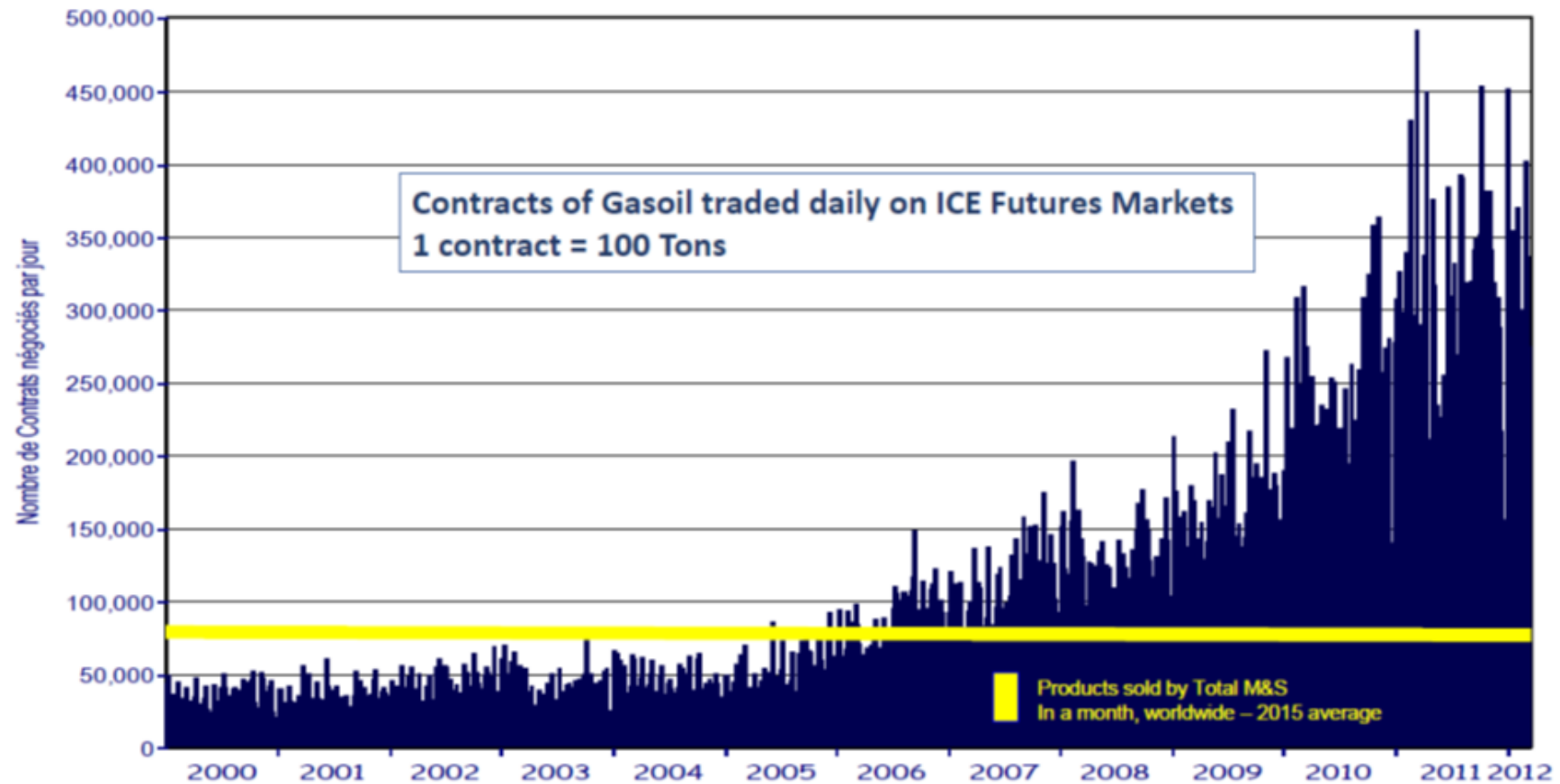
... pricing by reference to « **paper** » Markets

Oil majors (Total, BP, etc...) derive more earnings from trading financial derivatives on fossil fuel products than from Exploration and Production.

# What are those « financial derivatives »?

- **Forward**: a contract whereby you purchase a quantity of oil at a fixed price at a future date
- **Option**: a contract whereby you have an option to purchase a quantity of oil at a certain price in the future, but no obligation to do so
- **Put option**: option to sell, **call** option, option to buy
- **Shorting**: borrowing to purchase a massive quantity of puts.
- Financial derivatives were initially designed to **hedge** price fluctuations of the physical commodity (the oil). But it is possible to create derivatives endlessly on the same physical oil contract/quantity (rather, it has been allowed by an absence of regulation on those markets). Financial derivatives have become themselves profitable products to **trade**, rather than the oil or other underlying physical asset.
- The market for oil derivatives is probably 40 times the physical stocks (it is hard to tell because there is no central registry of derivatives).

# A continued surge in oil derivative trading





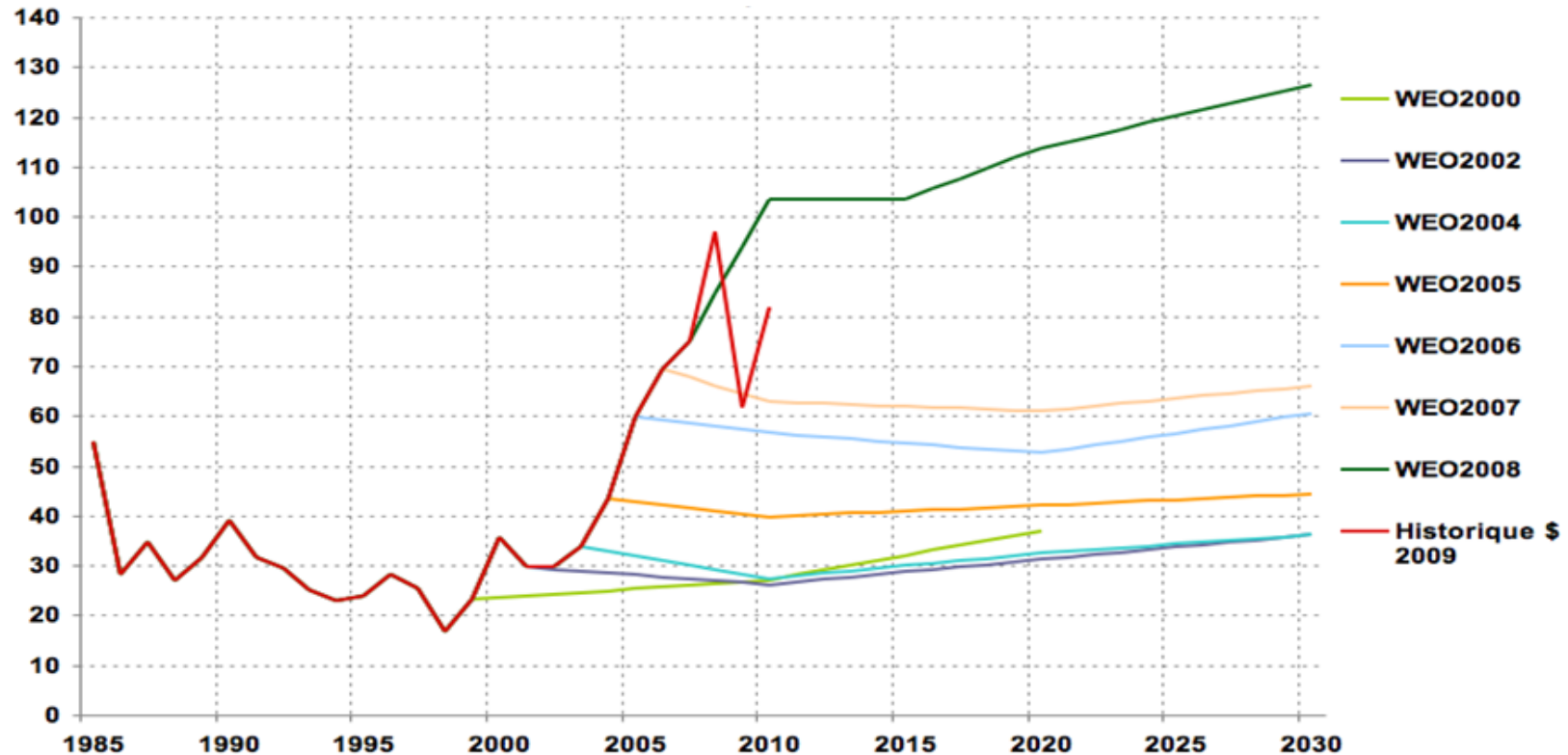
**As a consequence the price of oil is highly volatile...**



SOURCE: [WWW.TRADINGECONOMICS.COM](http://WWW.TRADINGECONOMICS.COM) | OTC

....Not only volatile but also not predictable

## Real price of the barrel in \$2009 and IEA forecasts from 2000 to 2008



# Such markets are called « efficient »

➤ Eugene Fama, who was awarded the « Nobel » economic prize in 2013, named « efficient » the markets that are described by the arbitrage theory, i.e. markets where profitable trading is highly difficult, and where there are no riskless gain opportunities.

➤ French mathematician Nicolas Bouleau demonstrates in his latest book « Le Mensonge de la finance » that on such markets:

✓ **Volatility is high**

✓ The increasingly sophisticated global, computerized trading makes volatility much more visible than the long term trend in prices: volatility ***kills the price signal***

✓ Therefore is detrimental to long term ***investment***

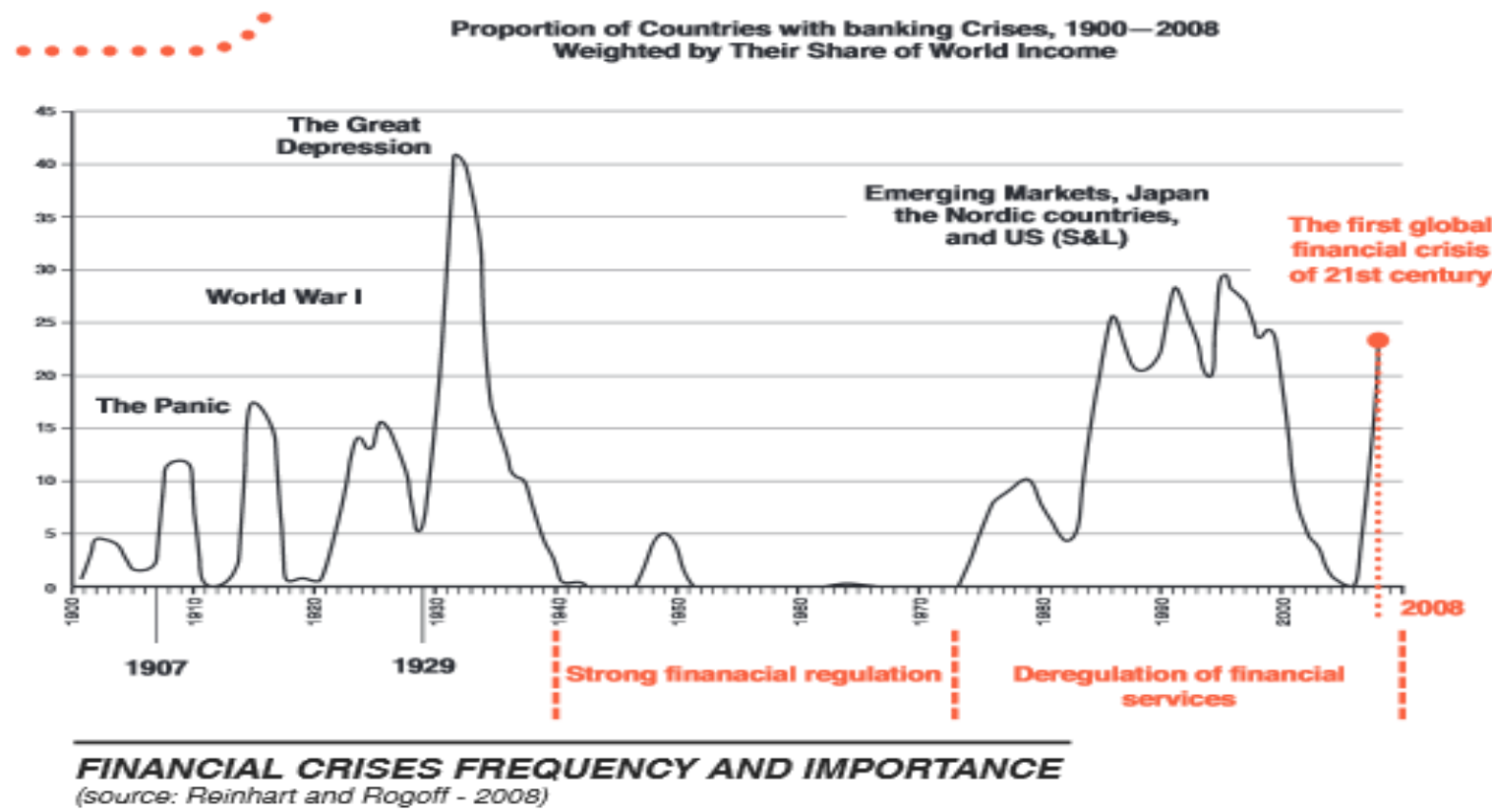
✓ And conceals ***scarcity***

$$PV = RT$$

$$\begin{aligned} & f(B(t)) - f(B(0)) \\ &= \int_0^t f'(B(u))dB(u) \\ &+ \frac{1}{2} \int_0^t f''(B(t))dt. \end{aligned}$$



## 5. Another essential link between energy and finance: CO2 and the strength of the dollar?



- Between 1944 and 1971 a monetary system ties advanced economies together: it's called Bretton Woods or the Gold Standard. The dollar's value is linked to gold (one ounce of gold is worth 35 \$) and all major currencies are linked to the dollar.

# Oil off shore extraction and the split of the international monetary system

- Between 1945 and 1970 the **US** needed to print massive amounts of dollars. The main source of this need for **monetary expansion** was the need to drill for oil offshore, and the choice to finance it off balance sheet, using the project finance technique.
- Suspecting that the US does not hold enough gold to meet its gold parity commitment, Germany asks the conversion of its \$ reserves into gold in 1971. Unable to deliver, Nixon unilaterally « suspends » (in fact terminates) the convertibility of the dollar into gold.
- This is the beginning of an **unstable monetary order** (rather, disorder) in which we are still living today.
- « *Currencies were allowed to float freely ; it was an illusion to believe that such freedom could be harnessed and made into a system. The free float of currencies had adverse consequences on our economies, and more generally on our societies* » J.de La Rosière, ex IMF General Director, « 50 ans de crises financières », p 76

# The end of the Gold Standard, the beginning of unbridled financialization

- Invention of derivative products in the 1970s to hedge the new risk of floating currency values
- They are later extended to other underlying assets than currencies: commodities, of which fossil fuels, interest rates, default risks...
- The business of banks is transformed: « Capital markets » ie trading activities will become increasingly important compared to lending or investing
- Same for commodity producers, of which fossil fuels: derivatives trading will grow so as to represent their main activities. In 2000 Enron fails because it was thought to be an energy producer, while it was an energy trader.

The unbridled growth of financial derivatives trading

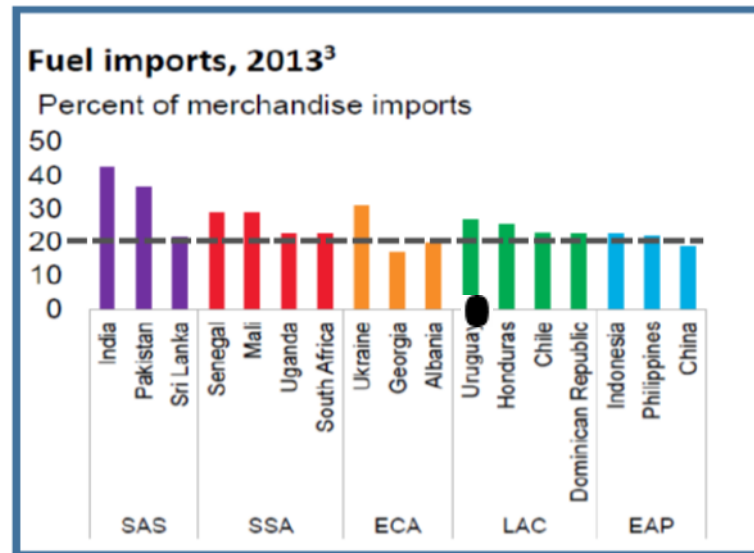


# At country level, energy and monetary dependency are linked: the Washington consensus

- The off shore drilling triggers **trade deficits** in developing countries, for instance as Mexico exports more and more oil to the US, and imports more and more manufactured products from the US. Terms of trade are not in favour of developing countries: trade deficits will become a major source of public external debt, in hard currencies, for the developing world.
- It is important to have in mind that only the developed world's currencies are **convertible**: the dollar (and « Middle East » dollars), the euro, the pound, the yen. All other countries cannot « buy » hard currencies on the markets. They can get hard currency (eg to buy oil) only by borrowing at the IMF/World Bank, or by exporting in hard currencies.
- The Marshall plan will also trigger an increase in **energy dependency** of industrialized countries towards the US, notably in Germany and Japan. In 1973 and 1979, oil exporting countries suddenly increase their prices. The energy bill rises both in industrialized and developing countries.
- The World Bank reacts with the « **Washington Consensus** » policy, which can be summarized as « trade, not aid »: further loans in hard currencies only if you open your borders to trade (lower tariffs) and capital flows.
- This triggers globalization, including financial **globalization**. Industry, banks and financial markets concentrate to become the large global players on the « efficient markets », as described by Nicolas Bouleau. The best performing countries are in Asia, those who refused to fully open their borders, trade and capital markets to globalization, notably India and China.

## 6. King of pain: oil dependency and growth

- Oil represents 40% of Indian imports, 30% of Senegal, Mali, Ukraine, 20% of Uganda's, South Africa, Chile, Indonesia, Philippines, China.



- The drop in oil price in 2014/15 boosted those countries' growth, but it wrought havoc in Venezuela, an oil exporter, triggering a 8% drop in GDP and a massive capital outflow (\$ 80 bn) resulting in a violent social crisis.
- The crown jewels: Resource peaks and monetary hegemony
- <http://onlinelibrary.wiley.com/doi/10.1002/sea2.12042/full>



# The transition – let's put solar panels in India

- India will need to borrow in dollars (or another hard currency) to purchase the panels (unless it manufactures them itself, but India does not have the technology or the raw materials to do so).
- India cannot repay a loan in hard currency because it exports too little.
- So let the IMF extend a new loan to India to acquire solar panels, with a long maturity to allow for India to develop new exports to repay the hard currency loan on the basis of the new energy.
- This needs to be voted at 85%+ at the IMF, where the US has a 16% voting right.
- Should India significantly increase its energy autonomy, the relative value of the rupiah would increase, and the relative value of the dollar decrease.
- The **incapacity of developing countries to borrow in hard currency** to finance the transition is a major obstacle to the fight against climate change, but also a considerable loss of export opportunities for advanced economies, including the EU.

# Some further thoughts for the transition

- After the financial crisis the IMF issued a massive 320 bn loan to all countries in the world to face the crisis
- Given the current level of public indebtedness in emerging but also developed countries, it has been argued that such an « **IMF transition loan** » should be made to invest massively in the transition.
- However not the US but China is now the main holder of US Dollars. What's going on is that China has started to invest massively its dollars abroad. This is called the « **Belt and Road Initiative** » and is about \$ 70 bn over the coming years. One of the European projects is Hinkley Point, the EDF nuclear project in the UK.
- But there is no guarantee, to say the least, that the BRI will be green....
- In today's globalized, open borders and free market economy, there is no regulatory space to impose a « top down » carbon price. Cooperation is a good idea, but it's hard to see cooperation given the extent of **currency wars**.

## 7. The way out – A call to the scientific community

- « Our priority should be to **rebuild an information and perception system** based on the ecological and social state of the planet, using non financial indicators, **based on physical stocks**. There is a new role there for the scientific community. Scientists are today the community which is the most common goods-oriented, the most prone to defend biodiversity, the most reticent to artificial hyper-productivity false solutions. Scientists are also first in line when it comes to worrying about the future, notably as climate change is unfolding. They must find with this a new basis for their message to society, and change from trumpeting unstoppable progress to bearing, more than others, the weight of the worries about the future, which they also understand the best.
- Scientists must radically debunk all beliefs in a would-be natural harmony created by global financial markets. The institutions that rule today's world (IMF, WTO, global financial institutions and think tanks), are spreading the dominance of finance not only in markets, this is done already, but also in the realm of values and beliefs, in people's minds. Those institutions are short sighted and smoke-producing. **They must be ring-fenced and their influence needs to be reduced.** The idea of a World Organisation for the Transition (WOT) must be fought for, it must grow through local initiatives until it gets politically empowered by a citizen's democratic consensus.
- **And science, untainted by selfish interests, should recover its capacity not just to think, but also to act, for the common good. »**
- Translated from Nicolas Bouleau, « Le Mensonge de la Finance », Conclusion p 201.