Energy and growth

By

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Energy and growth, a tautology?

From 1965 until 2015, that is over the last 50 years, the world economy (excluding inflation) has grown at an average of 3.7% per year. Over the same period, the worldwide energy consumption has grown (in volume) by 2.6% per year. By analysing year by year over the last 50 years, global economic growth and growth in the worldwide energy consumption, their correlation appears explicitly. The more the economy grows and higher the energy consumption becomes - *but with a correlation coefficient that decreases over time*, i.e. with an increasing energy performance, thanks to technological developments (see table 1).

There is no human activity that is not, directly or indirectly, energy-consuming. It takes oil to produce the fuel needed for transport (air, road, sea) or agriculture (agricultural machinery), gas for domestic and industrial heating, gas and oil for manufactured products (plastics, cosmetics,...), coal to produce steel and cement (building and construction), and electricity (coal, gas, nuclear or renewable) to supply railway and urban transport, to enable domestic use (lighting, appliances), and to operate electro-intensive industries (iron and steel, metallurgy, chemicals, glassware,...).

Even digitalisation do not escape from energy consumption. The development of Amazon for example, even if it is e-commerce, is largely supported by a physical distribution network, consumer of fuel on one hand and a "physical" digital industry on the other (computers, smartphones, servers, cables and fiber optics,...) which is also energy-consuming. *For Amazon, these two elements represent a worldwide energy consumption corresponding to the annual production of a magnitude of 1 to 2 nuclear power stations.*

Even financial services. They are heavy users of equipment and IT infrastructures (computers, servers, cables and fiber optics,...). Their added value is strongly concentrated in the wages of their employees, who need housing, to eat, heating, to be equipped, to communicate, to be educated, to have medical care, to move around, to be entertained, etc... which is, again, an energy consumer.

Energy resources, primarily fossil fuels, and therefore finished

The majority of the world's energy resources are fossil: oil, gas, coal. These three resources represent more than 75% of the energy consumed worldwide. *This will remain the case for the next ten years at least, regardless of the scenarios and the will to change the energy mix.*

Their existence is the result of a geological process which lasts millions of years, the quantity on the planet can be seen as having a given limit, at least on the horizon of a lifetime or of human civilization (between a little less than a hundred to a few thousand years). And this, whether all of the existing reserves are already known and available or not.

In the case of oil (the first energy resource worldwide, representing around 30% of the total energy consumption), exploration activity, significant since the beginning of the twentieth century, discovered a maximum of oil reserves in the middle of the 1960s. Since then, the 'black gold' reserves discoveries are in a clear decreasing trend - and this, despite the recent discoveries in the Kazakhstan or off the coast of Brazil (see table 2).

The discovery of oil having experienced a maximum in the past, it is certain that oil production (or more precisely its extraction) will also experience a peak, in a more or less

near future. It is the same for gas and coal, and therefore for the available fossil energy as a whole. The only key question is "when?" (see table 3a).

Whilst today oil production seems excessive and prices low, there in only thing that is certain in the short or medium term: prices will rise if the global economy continues to grow.

A risk to global growth - except with technological innovations

Growth and energy being correlated, and the available fossil fuels being bound to get to a maximum (i.e. growth slow down, then a decrease), there is a risk that global economic growth will be under greater and greater pressure in the future.

However, this reasoning is only valid with constant technologies and energy sources.

It is still hoped that technological innovations can release a little (or a lot in the long term?) the energy constraints; the development of new energy sources (like, for example, hydrogen engines or fusion) and the increase in the productivity of engines (cars, trucks, airplanes and agricultural machinery), the performance of power stations and batteries (computers, smartphones and electric cars), the energy efficiency of buildings, etc… hence generating, with the same amount of energy, more economic growth.

An increased polarization of the growth sources

In an economic world under growing energy constraints, (at least in the next 20 years, and beyond without technological innovation), it is likely that the growth levers will be more and more polarized.

In terms of geographies, the critical nature of access to energy resources should strengthen. The countries who will benefit will be those who have some on their territory (ex: a limited number of countries in North America[1], South America[2], and the Middle East[3], Russia, China[4] and India[4]...), those who have the financial resources to obtain them (ex: China), or those who have the technology to partially reduce their dependence on (ex: France, United Kingdom, China with nuclear power).

Beyond the issue of access to resources (i.e. energy supply), the effectiveness of their use (i.e. the energy demand) is also critical. This is the real challenge of "energy efficiency", or on a wider scale, the significant evolution of habits towards more efficient modes of energy consumption.

Thus, in terms of activities, the development of energy efficient businesses should probably be expected, provided that they are at the same time competitive (in supply, price, and cost). This concerns all the existing industries, with for example:

- Agriculture and food (vegetable crops rather than cattle, high energy consumers throughout its operating cycle). Did Bill Gates not invest in Impossible Foods, a Californian start-up that develops vegetable protein burger recipes?
- Construction and housing (more thermal insulation, more wooden constructions when possible...);
- Heating (wood when possible), lighting (low voltage bulbs), energy efficient household appliances (energy efficiency labelling);
- The repair industry, re-use and recycling of materials and equipment (clothing, textiles, plastics, glass, domestic equipment...);
- Transport (small hybrid and electric vehicles, including of two wheels, rather than 4-wheel diesel drives - as long as the batteries are produced with no carbon energy sources), the freight (rail rather than road), tourism (less distant destinations,...).

1 USA, Canada

2 Venezuela, Brazil

3 Saudi Arabia, Qatar, Iran, Irak, Koweït, United Arab Emirates

4 Only coal

Some traps to avoid in "sustainable" activities

In this search for energy-efficient businesses, more resilient long-term against the energy constraint, there are some pitfalls to avoid. They come activities that are classified as "sustainable" activities a little quickly and often exploited by politicians.

For example, with regards to "renewable" energies. Their value is quite relevant when it comes to saving fossil fuels which are scarce and emit CO_2. As such, they should probably still be developed worldwide and occupy a larger share of the energy mix. However, the problems related to them are often not well articulated in public debate:

- *We restrict the energy issue to the question of the electricity mix, whilst electricity only represents a moderate share of the final energy consumed worldwide (around 20%);*
- *We restrict "renewable energy" to wind and photovoltaic power (< 2% of world energy), while the first renewable energies are - and for a long time - wood and water* (13% to 20% of worldwide energy depending on the scenario, see table 4), and more importantly, with more attractive cost competitiveness levels (see table 5);
- *Ecology and nuclear power are contrasted, whereas in the most ambitious scenarios of the International Energy Agency in terms of limiting emissions of CO_2, nuclear power plays a key role in the world*: with at least in time double the current production (see table 4);
- *We forget that gas plays a key role in helping to complete the equation of energy needs and the reduction of the use of oil (endured) and coal (desired - except if the technologies of capture of CO_2 are developed)*: with a constant share between 20 and 25% of long term worldwide energy *(*see table 4).

Who has the means to choose?

What are industrial or public actors who have the means to decide and to invest to accompany the evolution of the offer and described above, energy demand or influence these:

- Electricity companies?: the financial room for manoeuver is reduced given the reinvestment stakes in infrastructures and low prices (regulated prices that are kept low for political reasons and low market prices due to the development of subsidized production facilities);
- Oil companies?: their self-financing capacity is mainly mobilised for the defence of the core business (investment issues in exploration / production to maintain the activity);
- Gas companies?: their potential is significant but only for those who have direct access to gas fields (in Russia, Qatar, Iran, USA,...);
- The States?: the financial room for manoeuver is low in Europe (except Germany); the European countries that were able to decide to carry out breakthrough energy strategies in the 1970s no longer have the financial resources; only the major emerging countries (mainly China) have significant resources;
- Technological innovators?: their potential is significant today, for example in the image of Tesla (*batteries and electric cars) whose market capitalization (52 Md$) now surpasses General Motors*.

The main actors who seem to be able to really change things are ultimately some States who have substantial financial resources (such as China) and industrial players outside the energy sector who can innovate with success on a large scale (such as Tesla), for how long? After several years of deregulation, the major energy industrial players have finally little to say as they lack resources in a game that is beyond them financially.

What to do?

In a future where the energy constraint will harden in the long-term, the profitable growth levers will be focused between geographies (with energy resources) and businesses (facilitating energy-saving practices).

Investment options for businesses must be discriminated in a stronger way in this respect. Definite choices must be made, for example:

- Abandon long term investments in subsidized businesses (unsustainable);
- Invest in energy efficient industries: agriculture (including forestry) rather than cattle, urbanism in dense areas (buildings rather than individual houses), the short distribution channels, recycling, etc...;
- Focus on gas (notably liquefied) as an alternative to the reduction in use of coal (desired) and oil (endured) rather than on "renewable" energy.
- Anticipate a rise in the price of oil and an overstep of the highest historic 140$ per barrel (June 2008); but at what timeframe?
- Invest in the research for new promising energy sources (fusion, hydrogen engines) and storage solutions (batteries, dams,...);
- Not "bury" nuclear power too quickly, which could double worldwide in time, which corresponds to the construction of more than 6 French production parks in the world by 2040.

Hard choices given the extent of risks, the amounts and the duration of the investments, but which may be partially rationalized.

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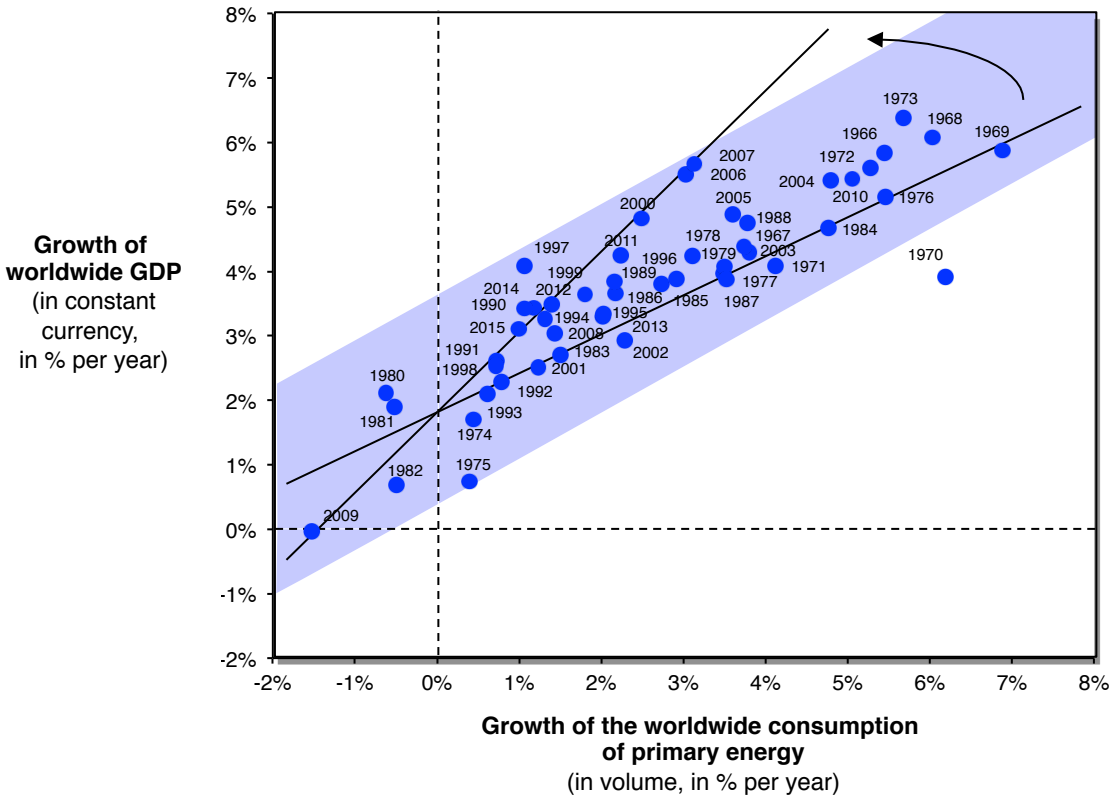
Estin & Co is an international strategy consulting firm based in Paris, London, Zurich, New York and Shanghai. The firm assists CEOs and senior executives of European, North American and Asian corporations in the formulation and implementation of growth strategies, as well as managers of private equity funds in the analysis and valuation of their investments.

- Table 1 -

Energy consumption and economic growth are correlated, with an increasing yield of energy consumed

World – 1966-2015

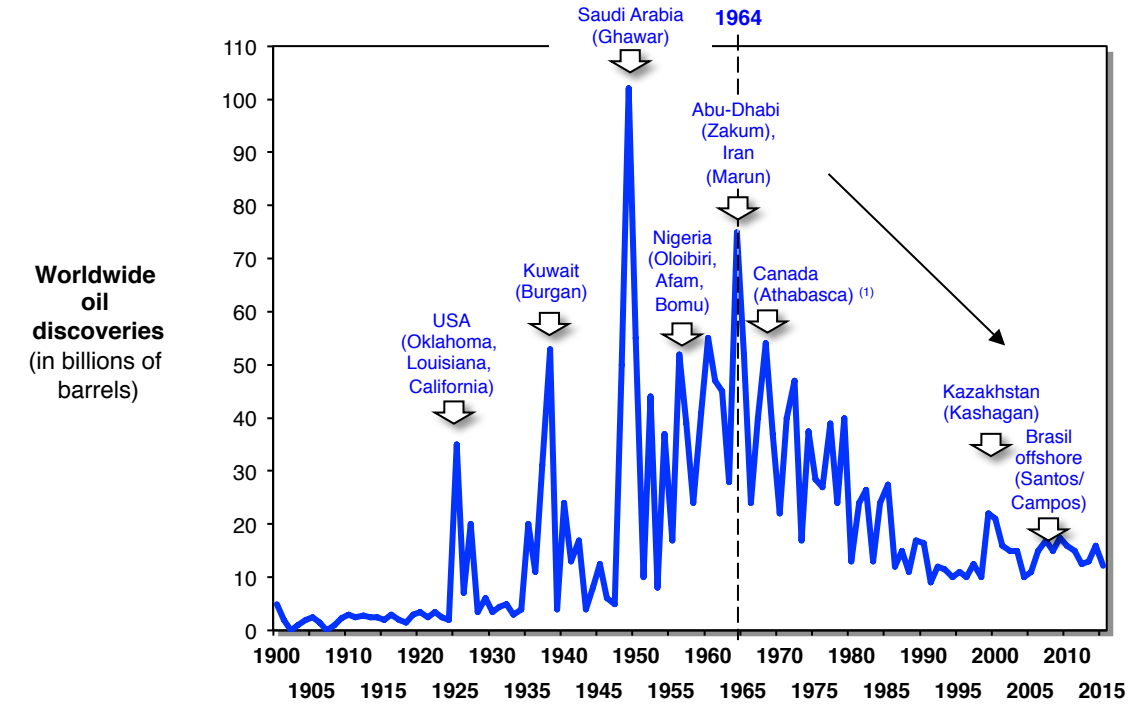


Sources : BP, Banque Mondiale, FMI, Estin & Co analysis

- Table 2 -

Oil discoveries peaked in the mid-1960s

Evolution of oil discoveries – World – in billions of barrels – 1900-2015

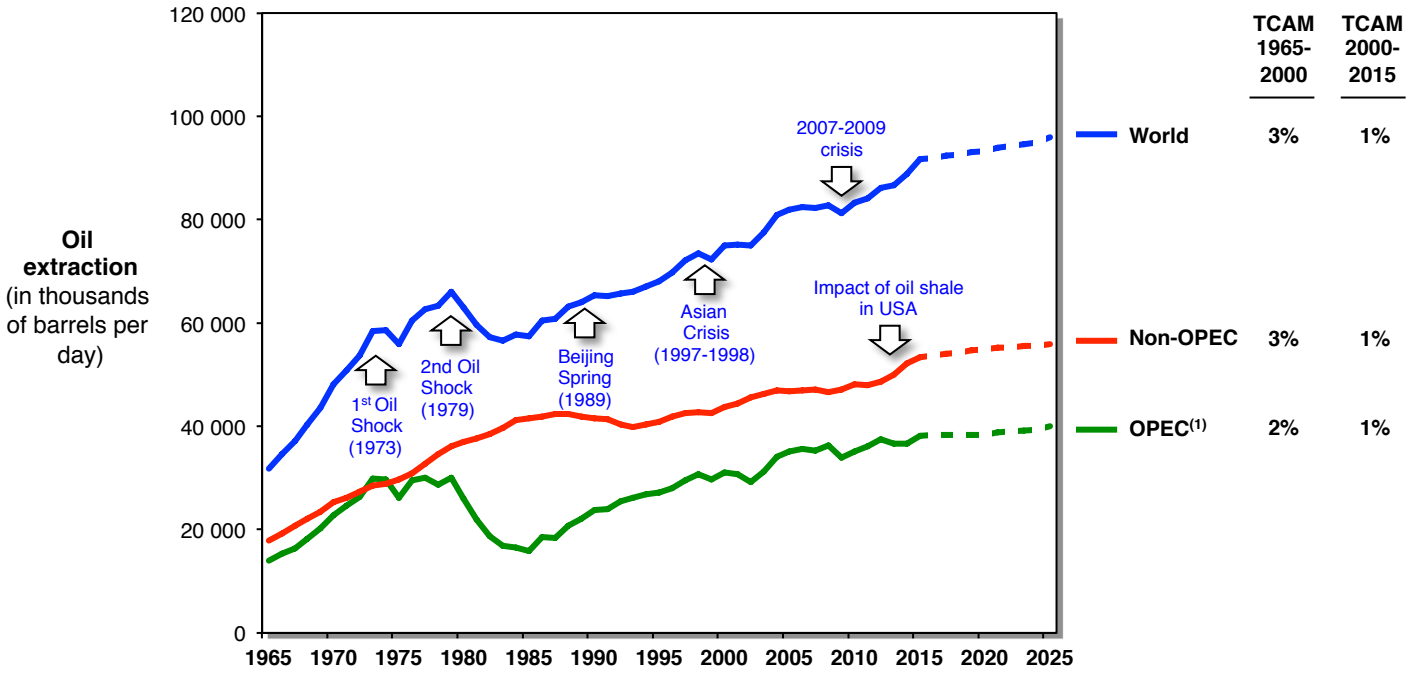


(1) First large-scale, economically viable oil sands operation
Sources : Jean Laherrère, Estin & Co analysis

- Tableau 3a -

When will global oil production and available energy reach their peak?

Oil production – World – Thousands of barrels per day – 1965-2015



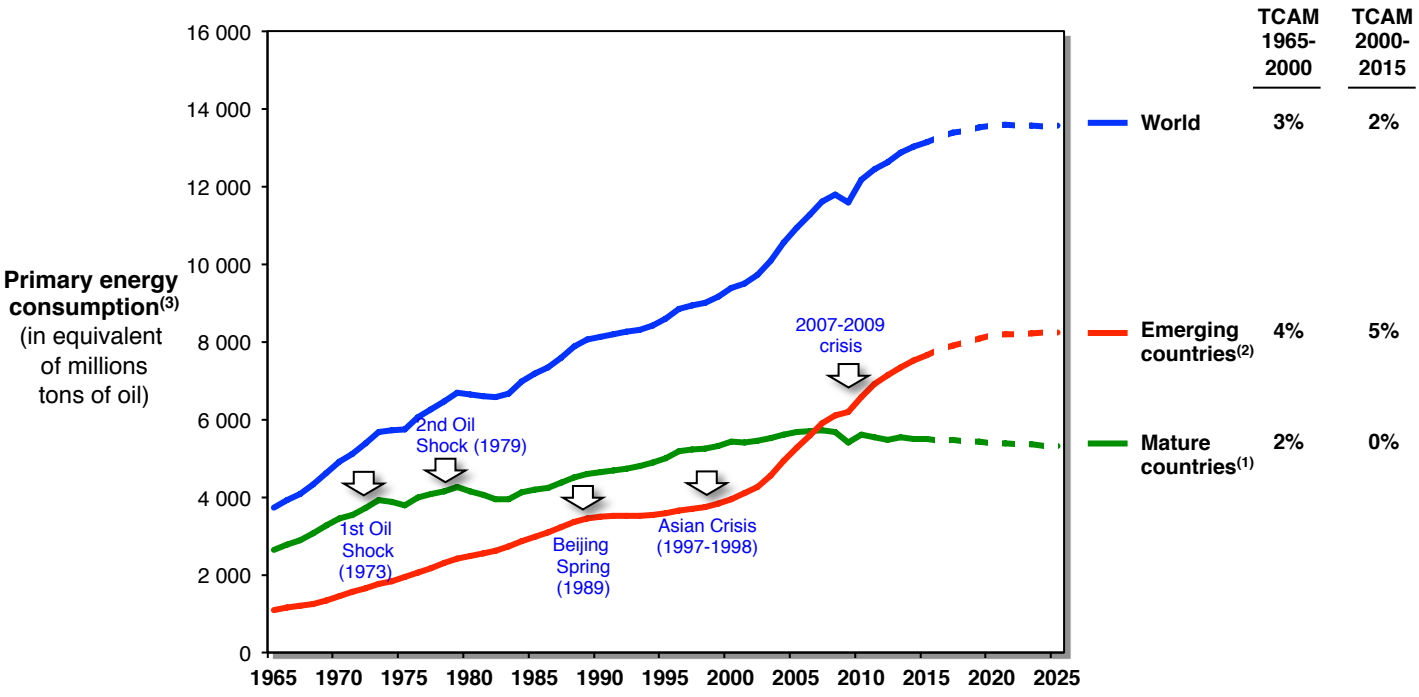
	TCAM 1965-2000	TCAM 2000-2015
World	3%	1%
Non-OPEC	3%	1%
OPEC(1)	2%	1%

(1) Algeria, Angola, Saudi Arabia, United Arab Emirates, Ecuador, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Venezuela
Sources : BP, United Nations, Estin & Co analysis and estimates

- Table 3b -

Primary energy consumption(3)

World in equivalent of millions of tons of oil – 1965-2015



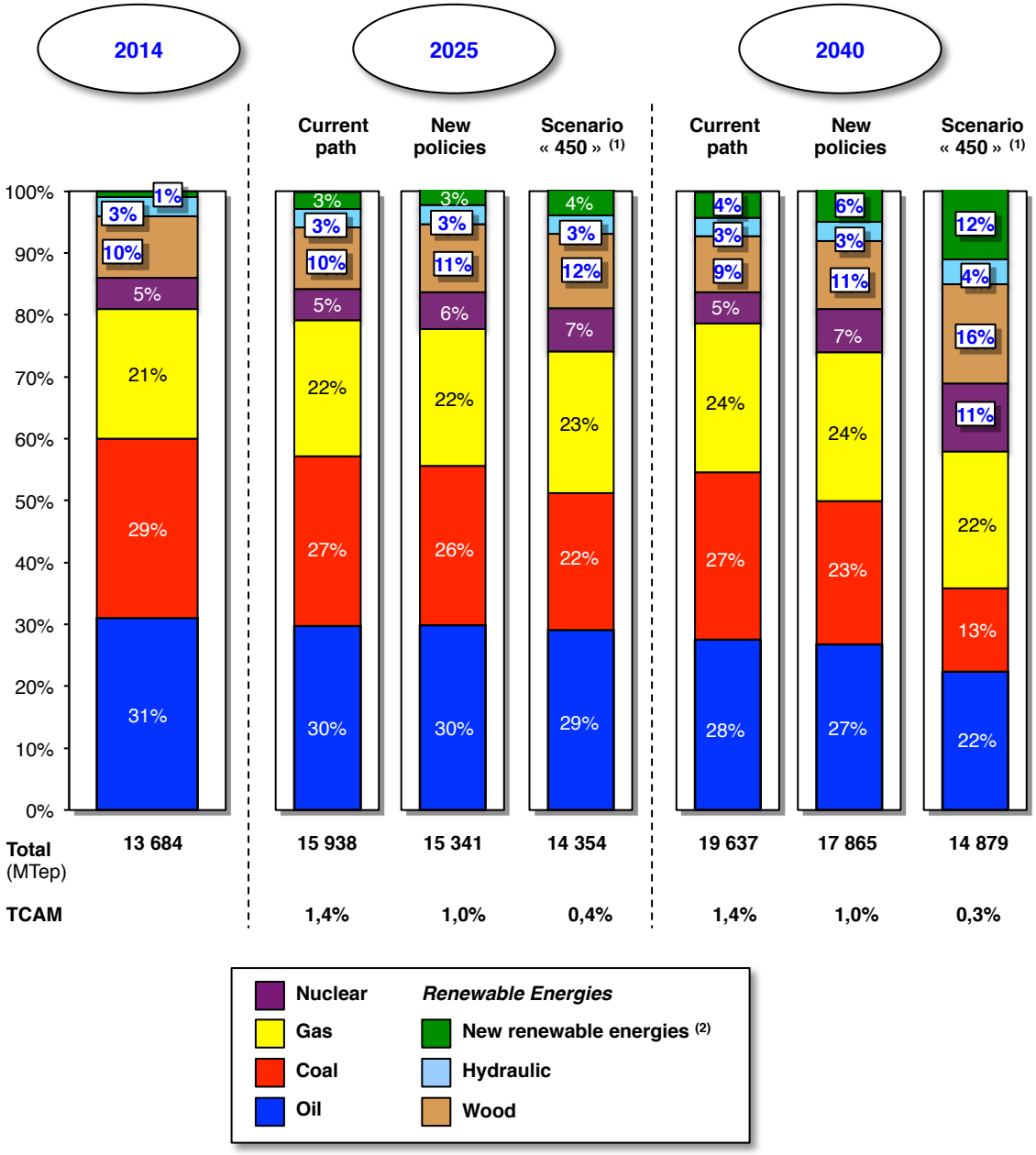
	TCAM 1965-2000	TCAM 2000-2015
World	3%	2%
Emerging countries(2)	4%	5%
Mature countries(1)	2%	0%

(1) OCDE : United States, Canada, Germany, United Kingdom, France, Italy, Spain, Netherlands, Sweden, Japan, South Korea, etc.; (2) China, India, Russia, Brazil, Argentina, South Africa, Pakistan, Indonesia, etc.; (3) Excluding wood energy
Sources : BP, United Nations, Estin & Co analysis and estimates

- Table 4 -

Wood and hydroelectricity represent the bulk of renewable energies, as opposed to wind and solar, today and in the long term

Scenarios of the evolution of primary energy demands – 2014-2040
World – International Energy Agency – World Energy Outlook 2016



(1) Scenario limiting the worldwide temperature increase to 2% by limiting the atmospheric concentration in CO_2 to 450 ppm
(2) Wind (onshore, offshore), sun (photovoltaic, others), geothermal, others…
Sources : International Energy Agency, Estin & Co analysis and estimates