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La transizione energetica è già iniziata, anche se la supremazia delle fonti fossili – carbone, petrolio e gas naturale – è ancora ben salda, e per molto lo rimarrà, a livello mondiale. A loro vantaggio hanno finora giocato diversi fattori: l'ampia disponibilità sul pianeta; il prezzo basso in termini relativi, quasi sempre inferiore a quello delle fonti rinnovabili; la facilità di trasporto e stoccaggio, che consente il loro utilizzo in modo estremamente flessibile dove e quando serve; la loro superiore densità e potenza d'energia: piccoli volumi contengono quantità elevate di energia utilizzabili in spazi limitati.

I dati (2011) relativi al consumo primario di energia nel mondo confermano questo quadro: le fonti fossili ne garantiscono complessivamente l'87%, l'idroelettrico e il nucleare rispettivamente il 6,5% e il 5,2% e le nuove fonti rinnovabili (eolico, biocarburanti, solare e geotermico) solo l'1,3%.

D'altra parte, un crescente ricorso a carbone, petrolio e gas si scontra quotidianamente con una opinione pubblica e una agenda politica sempre più attente e preoccupate del loro impatto sull'ambiente e sul clima. Infatti, come è noto, l'anidride carbonica prodotta dalla combustione delle fonti fossili è considerata da molti una delle principali cause (i gas ad «effetto serra») alla base del surriscaldamento globale dell'atmosfera terrestre e dell'alterazione del clima.

Per questo motivo, a livello internazionale e soprattutto nei paesi industrializzati si sta cercando di prendere accordi per ridurre le emissioni di gas ad effetto serra e si varano misure incentivanti le fonti rinnovabili.

La consapevolezza che in futuro si dovrà ridurre la nostra dipendenza da petrolio, carbone e gas a favore di un utilizzo più equilibrato del mix di fonti d'energia è ormai patrimonio comune. L'obiettivo di approdare tra il 2030 e il 2050 a una situazione in cui la quota di fonti rinnovabili e di nucleare (un'altra tecnologia *carbon free*) progressivamente cresce fino a sostituire in larga parte (o quasi del tutto) le fonti fossili, sembra troppo ottimista, specialmente se si tengono in considerazione i vincoli tecnologici ed economici che ancora oggi appesantiscono le prime.

Ma le politiche energetiche e ambientali dei principali paesi (in particolare quelli europei) vanno in questa direzione e tentano di combinare investimenti in ricerca e sviluppo, regolamentazione e incentivi pubblici mirati, seppure con politiche a intermittenza dovute alla crisi che da fine 2008 aleggia sulle economie occidentali.

Proprio per aiutare il lettore a capire quali siano le reali prospettive in questo campo e i problemi cui si sta cercando di trovare soluzione, il dossier di questo numero dà conto dello stato dell'arte degli studi sulle tecnologie per la produzione di energia senza rilascio di carbonio.

Nelle interviste e negli articoli traspare l'entusiasmo che anima gli attori di questa straordinaria avventura scientifica e tecnologica, i quali però non minimizzano le difficoltà connesse a questa transizione energetica di lungo periodo.

Sviluppare tecnologie per produrre energia pulita su vasta scala, così da sostenere una domanda mondiale prevista in forte crescita nei prossimi anni, non è cosa da poco. Specie quando si deve fornire *on demand* energia elettrica da fonti intermittenti come l'eolico e il solare. Fonti per le quali è necessario studiare e costruire nuovi sistemi di stoccaggio, trasporto e distribuzione di energia elettrica che devono integrarsi con reti esistenti che spesso fanno riferimento a standard tecnologici e impianti di produzione completamente diversi.

Ma il futuro pulito non è costituito solo dalle rinnovabili o dal nucleare. Altre tecnologie, come quella della cattura e sequestro dell'anidride carbonica, potrebbero consentire anche alle fonti fossili di continuare ad essere utilizzate senza appesantire il bilancio delle emissioni di gas ad effetto serra.

Per non parlare di quelle che consentono di ottenere lo stesso servizio consumando meno energia, ovvero l'ampia gamma di soluzioni che vanno sotto il titolo di ricerca dell'efficienza energetica. Probabilmente, molte di queste sono tecnologie già fin d'ora mature e utilizzabili consentirebbero di dare una risposta nel breve periodo.

Certamente sarebbe necessario riuscire a modificare le preferenze dei consumatori finali, affinché utilizzino nella progettazione e negli arredi degli edifici, nella scelta dei mezzi di trasporto e anche nelle loro attività quotidiane, «prodotti» a basso consumo energetico. Dobbiamo rendere evidente ai singoli che sostenere ora un costo di investimento superiore a fronte di una futura minore spesa energetica annuale in molti casi non solo conviene, ma va anche nella direzione della ricerca del bene comune.

In definitiva, la transizione verso un sistema energetico a basse emissioni di carbonio implica sia politiche pubbliche che scelte private, necessita di investimenti sia in ricerca e innovazione tecnologica, sia in fonti rinnovabili, ove plausibile e conveniente. E, ultimo ma non di minor importanza, non deve perdere di vista il fatto che per gran parte della popolazione mondiale il problema non è se utilizzare tecnologie pulite o tradizionali, ma è ancora quello di riuscire ad accedere all'energia necessaria allo sviluppo, in qualsiasi forma moderna si presenti.

DOSSIER: CARBON FREE TECHNOLOGIES FOR THE FUTURE

Solar Power, *Pasquale Alferj interviews Francesca Ferrazza*

The sun is an inexhaustible and free source of energy to be converted into electricity. A long and detailed interview with an expert guides us toward the future of solar technologies.

Keywords: Energy, Sun

Charging Batteries, *Maurizio Melis and Sara Occhipinti. With an interview to Bruno Scrosati*

Since the beginning of the era of electricity, energy is produced and consumed at the same time. The development of a large energy storage capacity would mean a great change in the energy landscape: it would allow electric mobility and a large diffusion of renewables like sun and wind, that are not continuous. Unfortunately, today batteries are still too expensive to be associated with renewables, and too heavy to trigger the boom of a large electric car fleet. But according to various market analyses, other applications are closer to be economically competitive, like energy security, peak shaving and anti-blackout systems.

Keywords: Energy, Batteries

The Energy of Kites, *Giuliano di Caro*

Kite Gen is the last evolution of wind energy exploitation. It is a radically new and innovative concept that may be the most practical and sound solution, in the market of renewable sources, to the world's energy needs and problems. These are the expectations of the visionary project developed by

Italian engineer Massimo Ippolito, who leads the Kite Gen Stem research and development team. In Sommariva Perno, a hills district in the Italian north western region Piedmont, Ippolito and his partners have built a testing prototype of this groundbreaking robot. His Kite Gen Stem has already produced a relevant amount of energy from the virtually endless and almost universally available energy power: high altitude wind. Ippolito's creature, suitable for any territory, as he underlines, is the result of a think-outside-the-box process: large wings, driven by a high-tech control system based on avionic sensors, fly at high altitude, harvesting the energy of powerful winds, much faster and constant than those available to traditional wind mills. According to Ippolito, he and his team are a few months away from the state-of-the-art development of this hi-tech wonder, that (hopefully) might change the world.

Keywords: Energy, Wind

Carbon Capture, Pasquale Alferj interviews Mario Marchionna

Reducing CO₂ emissions, stabilizing the climate and playing safe. The carbon capture technology is at the centre of the current debate, and pilot plants have started to function. From now until 2050 the watchword is «decarbonise». Carbon capture and storage is one of the main carbon-free technologies, because it allows the treatment of carbon dioxide present in industrial emissions.

Keywords: CO₂ Emissions, Carbon Capture and Storage

Fourth Generation, Maurizio Melis

The IV generation nuclear plants are supposed to solve many problems: they will improve safety and efficiency, and will give for the first time ever a convincing answer to the fuel cycle quest, being able to burn and destroy even the III generation nuclear wastes. But IV generation is not just a «small

step» but a «giant leap» for nuclear technology. All of the six IV generation families require brand new materials, and very challenging solutions. Although no commercial plants are expected to be available before 2030, all the countries with a strong nuclear industry are trying to find their own way toward the future of nuclear energy. The race is open.

Keywords: Energy, Fourth Generation Nuclear Plants

Green Engines, Riccardo Geffer Wondrich interviews Simone Padoan

The Italian bio-fuels market is relevant but still in an early stage of development. Geographical constraints such as land availability oblige our country to import bio-diesel and bio-ethanol to fulfill EU requirements. Ethical and environmental issues suggest to foster research and development of new generations of bio-fuels. New forms of supply chains and public-private-partnerships are needed in order to take advantage of the opportunities opened by the innovative technologies.

Keywords: Bio-fuels, Innovative Technologies

The Time for Efficiency is Now, Maurizio Melis

Every day we waste an enormous amount of energy. It is the result of more than a century of economic development based on low cost fossil fuels, with no attention at all for saving energy. For these reasons saving energy is not so hard, and as opposed to what happens with renewables, today energy efficiency is already competitive with traditional energy sources. In other words NegaWatts are definitely less expensive than MegaWatts, as stated by the International Energy Agency. There are many solutions available in the field of industry, buildings and mobility, that can save both energy and money. The time for efficiency is now.

Keywords: Energy Waste, Energy Efficiency

INSIDE THE CRISIS

The Capital Pretense, *Geminello Alvi*

In bank accounts, the fictitious capital, the capital created in excess, disappears. But hard-working and industrious citizens feel its effects on their impoverished incomes.

Keywords: Fictitious Capital

NATURE AS A LIMIT

Certainties and Uncertainties on Climate Change, *Thomas Schelling*

As Thomas Schelling says, climate change is a «bundle of uncertainties», and in the last thirty years the range of uncertainty has increased. How much global warming will result from various levels of greenhouse gases? How will such levels affect climates? How will those climate changes impact on productivity, health, comfort, recreation and everything else? One of the greatest difficulties is imagining the kind of world we shall be living in when these climate changes begin to be serious, 50 or 100 years from now.

Keywords: Climate Change, Uncertainty

INTERNATIONAL LETTERS

Clean, Safe, Virtually Unlimited, *Roberta Giaconi interviews Osamu Motojima*

What if the solution to all the world's energy problems was something we have always had in front of our eyes, in the Sun? This is what the sci-

entists of ITER – the international project for nuclear fusion – are trying to find out. The experiment aims at demonstrating the viability of fusion power which is the energy source of the Sun and the stars. However the outcome is uncertain, the costs are high and the implementation schedule very long. We talked to Mr. Osamu Motojima, Director-General of the ITER organization, about the ongoing project.

Keywords: Energy Problems, Sun

Warmth from a Leaf, *Camilla Minarelli interviews Daniel G. Nocera*

A team of researchers of the Massachusetts Institute of Technology, led by professor Daniel Nocera, has created the first example of artificial leaf. The artificial leaf is a solar cell, the size of a poker card, capable of simulating the process of photosynthesis, used by green plants to convert sunlight into energy and water. The device is made of silicon and electronic parts and uses catalysts that speed up chemical reactions, without which the reactions could occur, but very slowly. The device splits water into its two components, hydrogen and oxygen, which are then accumulated in a special fuel cell, which uses the two elements to produce electricity. By placing the device in about four liters of water, with a little sunlight, one day you may provide energy for a house in a developing country.

Keywords: Energy, Leaf

The Soft Transition. *Enrico Bompan interviews Richard Heinberg and Asher Miller*

The post-carbon era has started in Santa Rosa, California. For ten years the Post-Carbon Institute has been studying the implications on the economy of the changes of the energy paradigm, and its effects on the cultural and political lives of citizens.

Keywords: Soft Transition, Post-carbon Era

GEOPOLITICS FOR ENERGY

Talking at the Dinner Table, *Sara Rossi*

I visit Egypt for the first time and try to understand something about this country. Last spring I was watching the images from Tahrir Square on the news, and I was wondering: that boy or that lady over there, what do they talk about with their family? Is the revolution in the streets or has it arrived at the dinner table?

Keywords: Egypt, Revolution

The Future of Globalization according to Dani Rodrik, *Elisabetta Nones*

Dan Rodrik urges us to work on the 3.0 version of capitalism. After Adam Smith, author of the 1.0 version and Maynard Keynes, who inspired the 2.0 version, 3.0 is the version of fully-fledged capitalism, i.e. globalization, which will need an adequate governance not modelled on the economy.

Keywords: Capitalism, Globalization

Middle East: Oil Income and Political Change, *Daniele Atzori*

The rentier state theory identifies a relationship between the economy of the oil exporting countries and the nature of their states. According to this theory, the «oil disease» has spread to the whole Middle East and North Africa, being a major factor in the emergence of authoritarian regimes. In July 2011, Hazem Beblawi, one of the main theorists of the «rentier state» paradigm, has been appointed Minister of Finance of Egypt. This article explores to what extent the rentier state theory can still provide a conceptual framework to understand the contemporary MENA region, as well as

contributing to the implementation of economic reforms that can realise the aspirations of the Arab spring.

Keywords: Oil, Political Change

The Narrow Choice of President Obama, *Phil Sharp*

Are the United States doing enough in order to face climate change? Although the answer is no, the truth is that this is not the whole story, and the answer is not easy. Starting from here, Phil Sharp, charismatic leader of the American organization Resources for the Future, explores the wide (and in certain cases even contradictory) range of policies and actions against climate change implemented by the United States. Although the current US political scenario doesn't seem to give hope for a nationwide major environmental policy, there is some good news that might change the whole scenario: a significant and unexpected increase of the internal natural gas supply (due to a groundbreaking scientific discovery), or the major set of laws and efforts originating from the awareness of the political community and civil society in California, one of the leading American states.

Keywords: U.S., Climate Change

The Russian Arctic, *Francesco Maria Cannatà*

The Arctic is more than an economic space: international interest in the region is growing due to the consequences of climate change and the Arctic has become a political issue. The countries bordering on the Arctic Sea are striving to expand their rights of use in terms of space and content. The basic question is whether modern maritime law or special common laws of the country on the Arctic Sea apply. Even if the Convention on the Law of Sea will probably be applied, Russia and Canada could manage to push through special rules by appealing to historic titles. The Arctic and sub-Arctic zone make up a fifth of mainland Russia. The Russian Federation is one

of the region's most important countries and has considerable influence on whether the ecological and economic interests in the Arctic are settled by cooperation or confrontation.

Keywords: Russian Arctic, Climate Change

Indigenism and Nationalisations: Morales' Bolivia, *Veronica Ronchi*

After some years of neoliberal supremacy, with a party system based on coalition governments, the Bolivian society, from 2005, is leading a state transition guided by a political project that includes both nationalist and indigenous elements. This project also proposes alternative patterns for decentralization and political participation, which permitted better living conditions in the country and result particularly interesting for a socio-economic analysis.

Keywords: Bolivia, Political Participation

THE WORLD ON PAPER

Birth of a Nation?, *Franco Farinelli*

The new nation described in the article is South Sudan. In the Western world, shaken by the global crisis, the old centralized state does not seem to be working. Elsewhere, things are different, and seem to confirm Sassen's view that the National State plays a strategic role in the globalization process. A denationalized state that paradoxically transforms the objectives of its institutions in transnational goals.

Keywords: South Sudan, National State