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Inflation, nuclear energy and Ukraine's reconstruction

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Abstract

Geopolitics is a comparatively recent area of knowledge, but the influence of geography in history has been an ever-present reality. A recent confirmation is the Russian invasion of Ukraine, inextricably related to geography.

This article deals briefly with three topics: *i* - the preliminary steps of planning the reconstruction of Ukraine, *ii* – the global energy crisis, and *iii* – the likely short- and medium-term developments concerning electricity generation in the EU.

Wars have many consequences, one of them being their impact on development, stopping many endeavors but promoting others. The first category includes losses in human capital and destruction of infrastructure. The second includes the development of armament industries. A global consequence of the Russian invasion of Ukraine is the disruption of fossil fuels trade leading to price increase and consequent inflation. Gas and oil are valuable depleting assets with a central role in the current inflation peak. At the moment – October 2022 – France presents a comparatively lower inflation in Europe, due at least in part to its reliance on nuclear energy for electricity generation.

The short term options for electricity generation in Europe may see the reintroduction or reinforcement of coal with very negative impacts on sustainability, or the adoption or reinforcement of the nuclear alternative, with the problems of spent nuclear fuel and safety concerns.

Keywords: Ukraine, Russia, Reconstruction, Inflation, Nuclear energy.

Introduction. Ukrainian economy.

Ukraine is the birthplace of many distinguished people that over the years made important contributions to the arts, culture and sciences. Being a Mechanical Engineer, I recall Stephen Timoshenko, born in Ukraine's Sumy Oblast (then part of the Russian Empire), and his worldwide famous books and treatises on Engineering Mechanics, Strength of Materials, and Elasticity. With the collapse of the Soviet Union, Ukraine become an independent nation in 1991. Figure 1 shows

the evolution of its GDP. A first period of decreasing GDP was particularly marked in 1994. Figure 2 shows the GDP yearly percentual variation. Starting in 1999-2000 a period of growth took place, illustrating a potential associated among other factors to its human capital. As most other countries, Ukraine suffered with the global economic crisis started in 2008 (the so-called sub-prime crisis in the USA), and this is well shown in Figures 1 and 2. Recovery started in 2009, with modest growth rates, to be suddenly interrupted by the start of troubles and military operations in the Donbass. An opinion on Ukraine's economic performance is given by Noah Smith, just before the 2022 invasion, [1], and the negative view presented associates the bad performance to hyperinflation in the initial period of independence, the limited variety of exports (data for 2020 for ex. in [2]), low intensity of manufacturing but also corruption.



Figure 1 – Ukraine, GDP (current USD).



Figure 2 – Ukraine, GDP % annual variation.

Losses associated with the Russian invasion of Ukraine are tangible and intangible. For example, the largest transport plane in the world, the Mriya (Antonov An-225), destroyed by Russians in the very early stages of the invasion (Feb. 27, 2022), had an economic value expressed for example by the cost of building a replacement. But further to that value, Mriya was an iconic aeronautical engineering design, with a worldwide crowd of followers that never failed the opportunity of going to airports anytime a landing of Mriya was announced. That interest was part of the intangible value of the plane.

Cost of, and policies for reconstruction.

Tim Marshall wrote very elegantly about the constraints of geographical reality in ‘Prisoners of Geography: Ten Maps That Tell You Everything You Need to Know About Global Politics’, where in the introduction and first chapter (‘Russia’) he exposes his interpretation of the influence of lack of mountains in Ukraine on Russian fears of receiving yet another invasion coming from the west repeating Napoleon and Hitler, [3]. As with Mackinder’s pioneering geostrategic ruminations [4], (conceptualization of the world organized in several regions with characteristic roles and identification of the ‘heartland’ and ‘pivot of the world’), purely geographical interpretations may seem out of our time given the ever-growing preeminence of the digital world. Nevertheless, as the current invasion of Ukraine shows, war is still fought in the battlefield, notwithstanding the parallel digital world which is less perceptible for common people but is pervasive, in geolocation, drone and missile maneuvering etc. .

It is too early for a definitive view on the task of rebuilding Ukraine, given that there is still destruction going on, presently aggravated by drone attacks to civilian targets including Kyiv. But it is certainly necessary to proceed with plans, considering several scenarios for the evolution of the situation given the associated uncertainty.

Many international instances are active in designing scenarios for the immense reconstruction task. Among these, the UN [5] and UNPD [6], the World Bank [7] together with the Ukrainian government and the European Commission [8], the German Marshall Fund of the US [9], groups of distinguished economists as in [10], OECD [11], [12], think tanks [13], consultants [14] and organizations concerned in guiding the reconstruction along sustainable and eco-friendly paths [15], are noted. In the perspective of [10], aiming at modernizing the country and preparing it for the future, the key principles of international aid for reconstruction efforts should be (*sic*):

- i) put Ukraine on the path to EU accession;*
- ii) establish a stand-alone EU-authorized agency with significant autonomy to coordinate and manage aid and reconstruction programmes;*
- iii) recognise that Ukraine must own its reconstruction programme;*
- iv) encourage and facilitate inflows of foreign capital and technology transfers;*
- v) focus aid on grants rather than loans;*
- vi) organise rebuilding around the principle of a zero-carbon future with minimal reliance on fossil fuels.*

All this must take place through procedures that prevent corruption. Grants instead of loans should be foreseen. Answers must be found for how to finance this immense task; some ideas are given

e.g. by Frum in *The Atlantic* [16], including reparations by the aggressor [16], [17], [18]. As a metaphor of the reorientation of Ukraine, even the railway gauge could change – from [16] *sic*: ‘rail network will have to be changed to the narrower European gauge in order to reorient Ukraine’s trade toward the EU’s major ports’. In conjunction with Ukrainian authorities some international organization should coordinate the global effort; several come to mind as the World Bank, the European Commission, even the G7 [19].

A first international conference devoted to rebuilding Ukraine already took place in Lugano in 4-5 July 2022, attracting representatives of many countries and international organizations. The ‘Lugano declaration’ includes an appeal to the ‘private sector, academia and civil society as well as actors at sub-national level, such as cities, hospitals and others, to enter into partnerships with Ukrainian counterparts’, thus reinforcing the concept that the support to Ukraine reconstruction should come from all sectors and should not be restricted to intergovernmental relations. This means that individual people, namely in ‘the West’, should feel convoked to contribute actively – for ex., EU researchers involving their Ukrainian colleagues in projects, etc.; as a personal note, for me this is a path initiated in 2001-2 as evaluator for the EU of research projects for the Science and Technology Center in Ukraine (STCU) [20], or more recently participation in Kyiv in an initiative of the National Aviation University [21].

Immersed in the hardships imposed to the country, the Ukrainian administration has shown resilience and will be able to integrate the scattered information on destruction into nation-wide programs. Together with the Office of the President of Ukraine, and Ukrainian government, the Kyiv School of Economics (KSE) keeps since February 2022 a database of destructions and losses, an activity supported by USAID, [22].

Accountability in the reconstruction is a major concern for every stakeholder, as is fight against corruption, [23], [24]. In [25] the European Commission spelled out reforms needed and steps to be taken by Ukraine in order to be granted candidate status, and these concern corruption and vested interests as well as money laundering, influence of oligarchs, selection of judges of the Constitutional Court of Ukraine and of High Council of Justice, and framework for national minorities.

How to calculate losses resulting from the invasion is a matter of current debate which will be deepened once this war comes to an end or at least to some cease of military operations. No wonder that the amounts for reconstruction put forward in various *fora* vary widely. Costs may be estimated accounting every single destroyed building, factory plant, infrastructure; such an estimate is an immense task given the scale of destruction witnessed. A brief survey of on-going studies was presented above.

Using a contrafactual strategy, an idea of losses incurred by Ukraine may be obtained looking at the evolution of GDP as a function of time. Already in 2014 a sudden drop of GDP was witnessed in Ukraine. Another discontinuity will take place when the GDP for 2022 is calculated. One way of evaluating losses is therefore to characterize the evolution of GDP between 2014 and 2022 and make the best estimate for subsequent years as if the 2022 invasion had not taken place. The difference between the real curve and the estimated curve is a loss attributable to the 2022 invasion.

Figure 3 is a schematic presentation of the concept: the dark blue line represents the evolution of GDP along the years, with a sudden drop attributed to event x in year '1'. The interrupted red line represents the best estimate of GDP evolution if event x had not taken place. After n years, the

losses attributable to event x are $\text{losses} = \sum_{i=1}^n \Delta_i$.

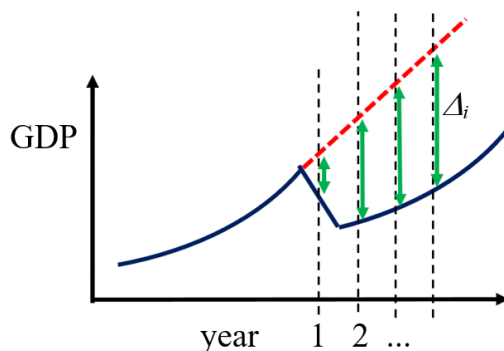


Figure 3 – Schematic representation of estimation of losses.

This is just an indirect rough estimate but it will give an order of magnitude. Calculations in these lines were already published by the Ukrainian economist Viktor Tsyrennikov [26]: considering the 2014 events and starting that year, he found estimated losses of the order of the trillion USD, to be compared with estimates obtained using other methodologies, below the trillion, see *e.g.* [27].

Global consequences. Inflation. Nuclear energy.

The current 17 UN sustainability goals are spelled out in the 2015 document ‘The 2030 Agenda for Sustainable Development’ [28], a step in the progressive acknowledgement of the need for change to ensure a future for humanity. In the context of promotion of the UN SDGs, a paper in *Nature* - ‘Redirect military budgets to climate and pandemics’ [29] - asks for a stop to the arms race, compliance with the Arms Trade treaty, and implementation the 2015 Paris climate agreement. Invasions and military aggressions as in Ukraine may be strong excuses to forget the above aims – as remarked by Pope Francis when he ‘*note[s] the interest in testing and selling weapons*’ [30].

The increasing attention of populations and governments to the effects of global warming and to the warnings of scientists concerning the climate emergency, led to the elaboration of plans for decreasing the GHG emissions, with ambitious steps concerning the decommissioning of fossil fuels power plants (coal, oil and gas), see *e.g.* [31, 32]. The European Commission included in 2022 specific nuclear and gas energy activities in the ‘EU taxonomy’ [33, 34], a transparency tool for companies and investors aimed at clarifying what is - or what is not - directed towards sustainability (European Green Deal, [35]).

A consequence of the 2022 Russian invasion of Ukraine was the turbulence of markets and a new geopolitical situation that led some countries to delay decommissioning or even to consider returning to operation decommissioned fossil fuel power plants – implying increasing difficulties to comply with the IPCC targets.

Nuclear energy is likely to return to the fore. The 1982 Portuguese energy plan [36] foresaw installation of 4 to 6 GW nuclear power up to 2010, but that possibility was rejected on safety and other grounds, even if Spain keeps two PWR in Almaraz, close to the border. France never ceased to dedicate attention to nuclear energy, and is reaping the benefits, particularly so when compared with Germany that recently decided to decommission its nuclear powerplants. Figures 4, 5 and 6 present the evolution along time of the percentage of electricity that is generated by a variety of technologies, for France, Germany, and Portugal [37]. These Figures illustrate the overwhelming predominance of nuclear in France, the struggles Germany is facing given its dependency on coal and decision to decommission nuclear power plants. Figure 6 illustrates the peculiar Portuguese situation, where in years with plenty of rain the hydro production is high and in dry years hydro had to be substituted by something else, particularly oil. In 1990 electricity was generated approximately in equal parts by oil, coal and hydro. Also in this figure, the growing importance of gas and wind is noted. This is not the place for details of each technology, suffice to mention that wind energy has the problem of intermittence and storage.

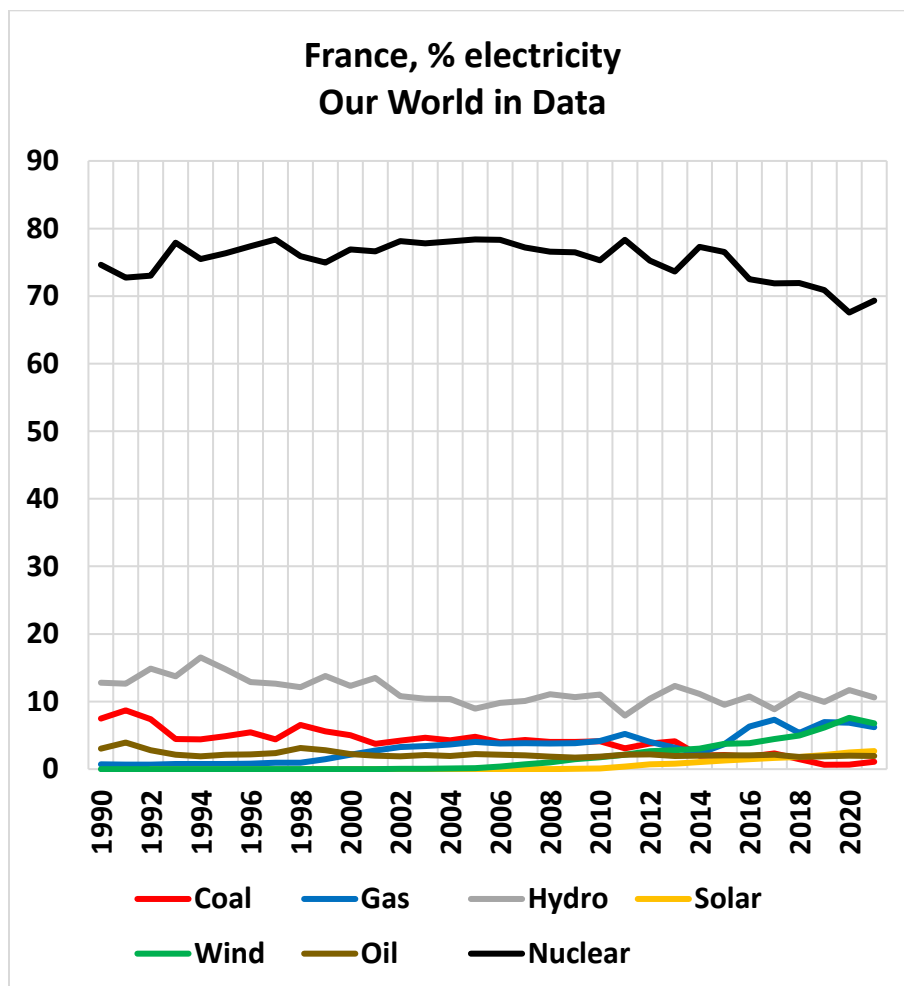


Figure 4 – France: share of technologies of electricity generation, [37].

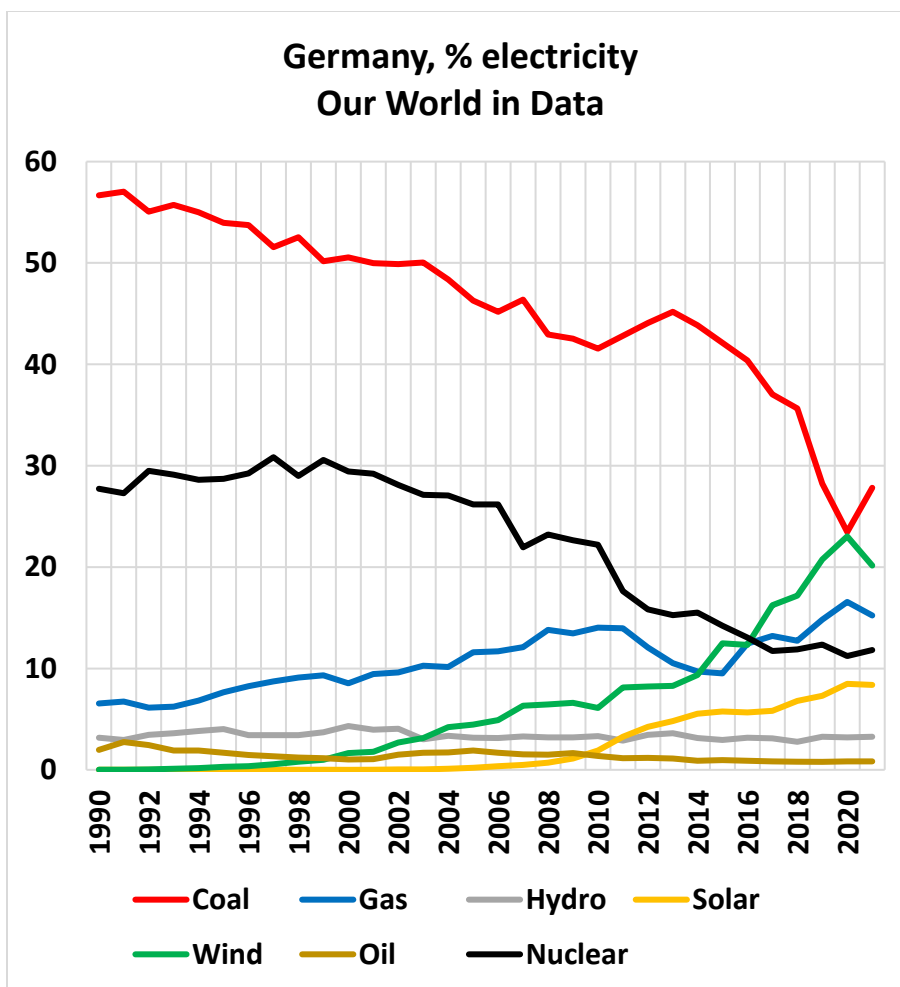


Figure 5 – Germany. share of technologies of electricity generation, [37].

A direct consequence of data in Figures 4 to 6 is inflation in the countries mentioned - Germany 10%, Portugal 9.3%, and France 5.6% in Sept. 2022. The comparatively good performance of France is related to its high energy independence. A rather unexpected consequence of the Russian invasion of Ukraine could be a renaissance of the nuclear energy elsewhere! For instance, a major Portuguese newspaper, *Público*, just published a panegyric in favour of nuclear energy, [38].

In Ukraine, plans for greening energy generation – like other plans – came to an alt due to the invasion. The situation before the invasion is dealt with in [39], with further details of the energy sector available *e.g.* in [40].

Being by education and training an expert in Fracture Mechanics – an area of knowledge with critical applications in aeronautics and nuclear power plants, among others -, one possible field for application of this background was the nuclear energy, that in the decades following my PhD progressively moved away from the favors of the public as a result of high profile accidents such as Three Mile Island (1979), Chernobyl (1986), and Fukushima (2011). It is ironic that nuclear energy might return as a savior for troubles derived from geopolitical adventures.

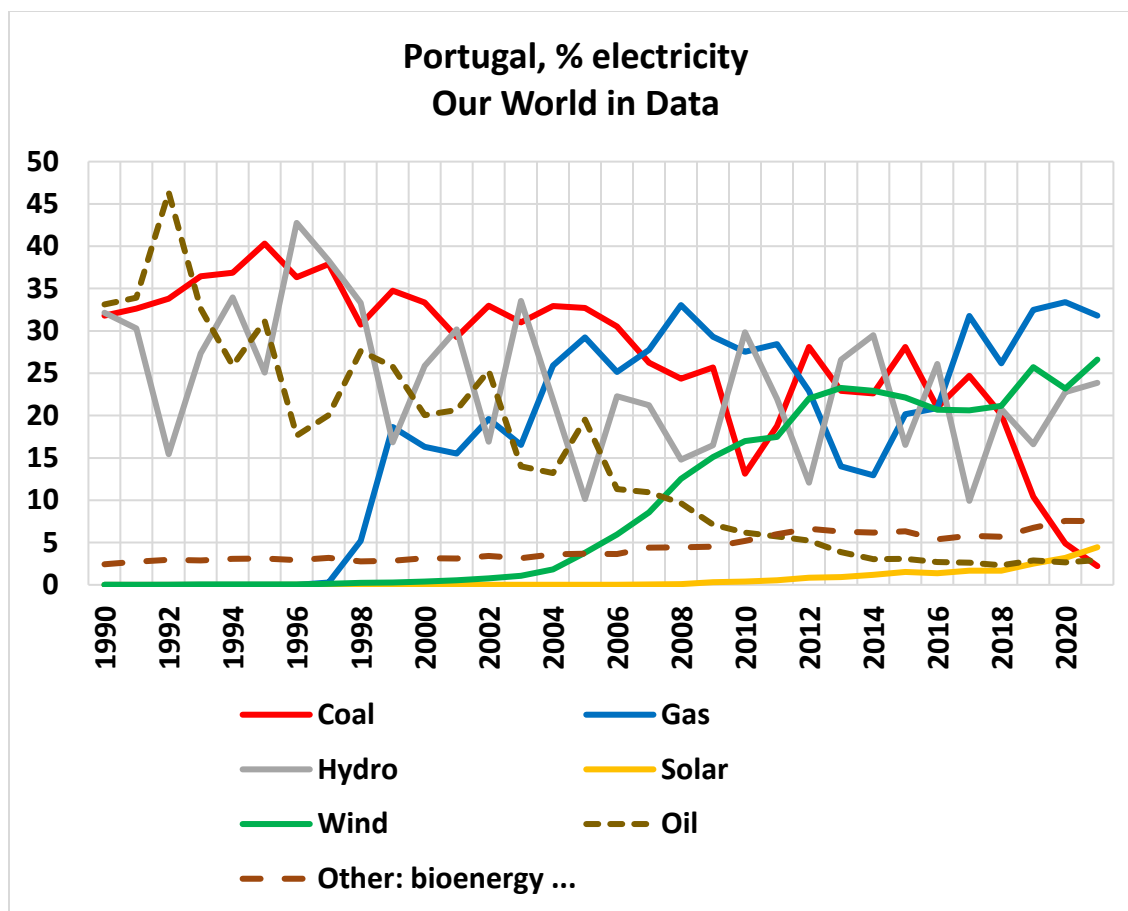


Figure 6 – Portugal: share of technologies of electricity generation, [37].

Concluding remarks

In 2022 the concept of using force to alter the *status quo* in Europe seemed unthinkable, when a reality check was imposed by the Russian invasion of Ukraine, bringing back the need to deal with the ‘law of the stronger’ – instead of complying with international agreements and law, and reminding the urgent need for redesign of the archaic UN Security Council.

Short and medium term needs related to Ukraine’s reconstruction are certainly not just a concern for Ukraine but a global subject where the involvement of international organizations, governments and common people is required.

Global consequences of the Russian invasion of Ukraine are short- and long-term. Among the first, inflation is noted. End of reliance on fossil fuels is likely to be delayed. Promotion of renewables is more urgent than never. Longer term is the probable renaissance of nuclear energy as a desirable means of satisfying needs for electrical energy.

Acronyms

EU	European Union
G7	Canada, France, Germany, Italy, Japan, UK, USA, EU

GDP	gross domestic product
GHG	green-house gases
IPPC	Intergovernmental Panel on Climate Change
OECD	Organisation for Economic Co-operation and Development
PWR	pressurized water reactor
r&d	research and development
SDG	sustainable development goals
STCU	Science and Technology Center in Ukraine
UN	United Nations
UNDP	United Nations Development Programme
USA	United States of America
USAID	United States Agency for International Development
USD	United States dollar

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