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Edited by Augusto Ninni and Luigi Oddo, OEET

CLIMATE CHANGE AND ENERGY TRANSITION

OEET organized its 9th Workshop on 14-15, December 2023 at Campus Luigi Einaudi, University of Turin, titled "**Economic effects of climate change and energy transition on emerging countries**".

The Workshop aimed at analyzing the current and expected impacts of climate change on emerging countries. On the one hand, all the countries (but mainly low-income countries) are plagued by its detrimental effects on the environment, which harm their inhabitants as producers (especially in the agricultural sector through famines, so that people lose job and income), and also as consumers (through increased prices), often pushing them to internal unrests, wars or migration. On the other hand, some emerging countries (mainly higher income countries) benefit from the adoption of energy transition policies (pushed by climate change) that bolster their competitiveness or allow them to exploit the surging demand for raw materials spurred by this energy shift. Furthermore, the situation becomes more difficult as high income countries are adopting energy and industrial policies strongly based on protectionist measures, which impact and modify international markets.

This issue of the OEET newsletter collects five contributions based on presentations given at the Workshop, under the form of extended abstracts. They represent also five different examples of the various issues discussed at the Workshop.

The first contribution, by *Elena Vallino*, analyzes the topic of water management in a large sample of countries. It utilizes different indicators to evaluate the influence of various factors on the availability and economic exploitation of water. It finds that institutions play a larger role than country income in determining high levels of water management and governance, especially in low- and middle-income countries. The text comes from the presentation titled "Good (or bad) water governance. A macro empirical analysis of the determinants of Integrated Water Resources Management", written by Andrea Pronti and Massimiliano Mazzanti, together with Elena Vallino.

The second contribution, by *Giorgio Brosio*, discusses the economic consequences (particularly at the revenue level) of the production and use of natural resources deriving from decarbonization and energy transition efforts. The analysis refers mainly to some Latin America countries, where production and exports of fossil fuels and large availability of natural resources requested by the process of decarbonization coexist, so increasing the role of the trade-off between long-term and short-term strategies. The text comes from the presentation titled "The impact of decarbonization and energy transition on fiscal revenues and their allocation. The Latin America case", written by Juan Pablo Jimenez and Ignacio Ruelas, together with Giorgio Brosio.

The third contribution, by *Andrea Pronti*, faces the issue of the trade-off between the economic success of water intensive agricultural crops on the international markets and the availability of local groundwater resources, as measured by the Groundwater Sustainability Index. As such, it deals with a typical topic of natural resources economy in a climate change time, in a case study through econometric instruments. The text comes from the presentation titled "Global exports draining local water resources: land concentration, food exports and water grabbing in the Ica Valley (Peru)", written by E. Zegarra, D. Rey Vicario, A. Graves, together with Andrea Pronti.

The fourth contribution, by *Xieshu Wang*, concerns the evolution of the electric vehicle in China, underlining the fact that it is the only country that has so far developed a full value chain of production, from raw materials to batteries, assembling and end-of-life recycling. It emphasizes the role of industrial policy as a tool to coordinate different solutions at different times, conducing to a product that eases the decarbonization and energy transition process, being very important from the environment point of view, for the country and for the world. The text comes from the presentation titled "The indispensable role of industrial policy: the case of the Chinese EV industry".

The fifth contribution, by *Augusto Ninni*, deals with the consequences on emerging countries of the industrial policies run by USA and European Union, and on the future of the photovoltaic industry. On a strategic side, their protectionist measures are not expected to be able to weaken the leadership of the Chinese industry. However, on a developmental side, the adoption of own industrial policies by a lot of emerging countries could favour their growth, in addition to world environment. The text comes from the presentation titled "Effects of industrial policies for energy transition on emerging countries".

Good (or bad) water governance. A macro empirical analysis of the determinants of Integrated Water Resources Management.

by Andrea Pronti, Elena Vallino and Massimiliano Mazzanti[1]

Robust and effective water management policies will be crucial for water security and global water issues in the next future. An efficient and socially fair use of water resources is indeed important for sustainable development, in particular if considered within the water-food-climate nexus theoretical framework. Beside the necessary condition of having availability of water resources, water governance and management are crucial elements for ensuring efficient, sustainable and productive water use for human communities. In our research work we aim at exploring at an empirical level the determinants of the diverse quality levels of water governance in the different countries.

The issue is highly relevant considered that a dramatically high number of individuals in the world experience situations of so-called economic water scarcity. Such condition occurs in areas in which there is a high level of water availability according to the main hydrological indicators, but people face severe difficulties in the sustainable use of water resources for livelihood purposes (Molden 2007, FAO 2012), because of a wide spectrum of complex reasons, from the lack of infrastructures to institutional inefficiencies (Marson and Savin 2015, Vallino et al. 2020). This contributes to the creation of water insecurity, that, according to Molden (2007), emerges when individuals lack secure access to safe and affordable water to consistently satisfy their needs for drinking, washing, food production, and livelihoods. UNDP (2006) estimated that about 1.2 billion people live in areas of physical water scarcity, while 1.6 billion people live in basins that face economic water scarcity. Notably poor people suffer the most from symptoms of scarcity and large structural inequalities are persistent. About a third of the people without access to an improved water source lives on less than $1 a day. Twice this share lives on less than $2 a day. More than half of the 1.1 billion people without access to safe drinking water is in the poorest 40% of the income distribution, while the association between poverty and lack of water for sanitation is even stronger (UNDP 2006). Clearly there are complex feedback loops between poverty and lack of water. The issue is relevant for many regions of the world. For example, in the Central African region water stress is inexistent according to current hydrological definitions, however indicators on water use and agricultural performance have low values. In Central Asian countries figures on water use in irrigation per hectare are relatively higher but disinvestments in the irrigation infrastructure led to high levels of waste of water resources and to environmental and economic damages in agriculture (UNDP 2006).

Several indicators of physical water availability are available (water scarcity, water stress, percentage of renewable water resources, data on transboundary water resources, on water inflows and outflows, on surface and groundwater, among others) (Schyns et al. 2015), however measuring economic water scarcity is challenging. We utilize the Sustainable Development Goal Indicator 6.5.1 ("Degree of implementation of Integrated Water Resource Management – IWRM") as indicator of the level of engagement against economic water scarcity in a country. The IWRM indicator provides information at a national level on legislative, managerial and financial environment for water management, on agreements for the management of transboundary watersheds and rivers and on stakeholders participation processes, covering 90% of the countries in the world. It is based on the responses to 33

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questions in a country self-assessment questionnaire, and it is constructed on a scale from zero to 100, depending to the estimated degree of IWRM implementation. We exploit the data waves of 2017 and of 2020 (UN Environment, 2018).

The correlation between the country's income and IWRM is present but it is far from perfect, with interesting cases of low-income countries performing fairly well in the IWRM level and high-income countries with only medium degree of IWRM. Therefore, we hypothesize that the Gross Domestic Product apparently is not the only crucial driver for investments in water governance. Similar dynamics hold for the correlation between the Human Development Index (HDI) and the IWRM. On the other hand, we observe that water availability loosely influences the IWRM level, leading to the consideration that more complex political and economic variables may determine the country effort on water governance and management. At the same time researches show that having a more sophisticated level of water governance has a positive effect on water consumption for the production of the most important agricultural products, leading to more efficient solutions from the point of view of water footprint (Vallino et al. 2020).

In order to empirically explore the determinants of IWRM we rely mainly on the World Governance Indicator (WGI) and its sub-components, and on the Notre Dame Global Adaptation Initiative index (ND-Gain index). The WGI provides information on the quality of government and institutions and it is produced by the World Bank, covering more than 200 countries and territories. The aggregate indicators are based on a high number of underlying variables, which, in turn, are taken from other existing data sources. The data report the views on governance of survey respondents from public, private, and NGO-based institutions worldwide. The main components of the WGI are "voice and accountability", "political stability and absence of violence/terrorism", "government effectiveness", "regulatory quality", "rule of law", and "control of corruption" (The World Bank, 2023). The ND-Gain Index is composed of a "vulnerability" score and a "readiness" score as composite indicators using 36 sub-indicators (University of Notre Dame, 2023). In turn, the "vulnerability" components are made by the following groups of sub-indicators: "exposure" (the level to which an area is exposed to climate change shocks from a biophysical perspective), "sensitivity" (the level to which a country depends on a particular sector negatively affected by climate change, or the percentage of the population vulnerable to climate change shocks), and "adaptive capacity" (the disposal of socio-economic resources for adaptation in specific sectors). The "readiness" components are: "economic readiness" (the capacity of a country's business environment to absorb investments that either reduce sensitivity to climate shocks or improve adaptation), "governance readiness" (institutional factors that enhance the application of investment for adaptation initiatives), and "social readiness" (information about social inequality, ICT preparedness, education and innovation environments that may enable investments in adaptation directions). Further we utilize a set of control variables, such as GDP per capita, water resources per capita, water efficiency, water stress, percentage of population with access to basic sanitation, percentage of population with access to drinking water, percentage of population with undernourishment, percentage of rural population, percentage of land equipped with irrigation, disbursement of aid for agriculture (DFA, containing the information of disbursement for environmental protection), Agricultural Orientation Index (AOI: relation between share of aid to agriculture and relative contribution to agriculture to GDP) (FAO, 2023).

We used an OLS estimation for analyzing the factors influencing the IWRM index using three equations. In the first we utilize the composite WGI, in the second we use the single WGI indexes, and in the third we use the ND-Gain Index. Preliminary findings suggest that, considering the composite WGI, the World Governance Indicator is not statistically significant for OECD countries, for which GDP seems to play a stronger role. It gains again significance for non-OECD countries and even more for low-income countries (non-OECD without BRICs). For this last group of countries, it seems that institutions play a larger role than GDP in influencing the IWRM level. Apparently there is a negative relation between water per capita and IWRM, even for poorer countries. We identify a positive correlation between water efficiency, water sanitation and IWRM, suggesting potential reverse causation mechanisms that require further investigation. Moreover, it seems that countries with low IWRM, and are more in need of support from cooperation, receive more aid in environmental domain. Additionally we observe that the higher the Agricultural Orientation Index (AOI), the higher the IWRM. If the WGI is decomposed and if we consider the model with all countries, we notice that only "government effectiveness" and "control of corruption" are statistically significant. If we consider non-OECD countries, only "control of corruption" and "rule of law" are significant. The Notre Dame Gain Index is significant with positive sign: the higher the country vulnerability to climate change and the higher is its readiness, the higher the IWRM. Water per capita and water stress keep significance with positive sign along the three models, showing a stable behavior. The relation of the IWRM and the country behavior in engaging in environmental treaties and agreements ("Quality of Governance Indicators" dataset, University of Gotheborg) will be further explored. Preliminary results suggest therefore that institutions play a larger role than country income in determining high levels of water management and governance, especially in low- and middle-income countries.

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The impact of decarbonization and energy transition on fiscal revenues and their allocation. Some indications from the Latin America case.

By Giorgio Brosio, Juan Pablo Jiemenez and Ignacio Ruelas[2]

Decarbonization and its fiscal implications

This short text aims at exploring the fiscal, more precisely the revenue impact, between and within countries, coming from changing trends of the production and use of natural resources deriving from decarbonization and energy transition policies. For illustrative purposes, it will refer to the case of some Latin America countries. The region is emerging as a leading producer of minerals demanded by decarbonization. At the same time, it is also a primary producer of fossil fuels. These circumstances produce winners and losers at the national level. There are also winners and losers at the subnational level since most Latin American countries share natural resource revenues between the central and the subnational levels of government.

Our work is based on a few political assumptions and some technological, economic, and fiscal facts, subject to variation over time. Assumptions refer to the commitment that countries took at COP21 held in 2015 in Paris to hold the increase in the global average temperature to well below 2°C above preindustrial levels and ideally to 1.5°C to avert catastrophic outcomes. COP28 held in late 2023 in Dubai confirmed this commitment, engaging countries to curb the production and use of fossils, although with several loopholes. It implies cutting greenhouse gas emissions to as close to zero as possible, with the remaining emissions captured.

Achieving final targets requires, from the technological point of view, shifting from the simple addition of new sources of energy to the full substitution of fossil fuels *i.e.* enacting an energy transition. In turn, investment in clean renewable energies and their use requires expanded production of critical minerals.

The final targets can be achieved with a combination of regulatory policies; granting of subsidies and public investments (all impacting on public expenditure); markets for trade of emissions and issuing of emissions permits; and finally of tax instruments, such as carbon taxes and specific taxes on fuels. There is a large space for substitution and complementing these policies. Our focus is quite narrow, but critical for producers of natural resources since it looks at the final impact of these policies and reactions to them by firms and individuals on their public revenues.

These revenues and their variation reach critical dimensions in countries specialized in the production (and use) of fossil fuels, minerals and "rare earths" required by the decarbonization process. These are called critical because of actual or possible future imbalances between demand and supply.

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Short analysis of the revenue impact and its risks

The revenue impact of decarbonization (and the consequent energy transition) is the net result of two opposite trends. The first one is positive and consists of the collections of taxes (or other instruments for extracting rents) levied on the production of critical minerals and rare earths. The second one is expected to be negative starting from the moment when countries experiment with a reduction of the production and consumption of fossil fuels because of a decline in demand following their policies.

Fiscal revenues from natural resources, including fossil fuels, are levied at two distinct stages, upstream and downstream. Upstream revenues, usually called royalties are collected at the moment of the production of the resource, be it the mouth of the well or the mine (or the port of export, when the resource is entirely sold abroad). The total revenue depends on the tax rate, the quantity sold, the price of the natural resources that is determined on the international market, and, very importantly, on the cost of production. The cost varies greatly among countries and determines the net rent, i.e., the base for levying taxes. More importantly, the cost determines when, in the case of critical minerals, a country will be able to enter the market (the price must be higher than the cost), or, in the case of fossil fuels, it will be forced to leave it (the cost becomes higher than the price).

Table 1. Oil extraction marginal cost. 2016

Country	**Exploration Type**	**Marginal Cost**	**Transportation**
Russia	Arctic	120	NA
	Onshore	18	12
Europe	Biodiesel	110	2
	Ethanol	103	2
Canada	Sand	90	15
Brazil	Ethanol	66	5
	Offshore	80	2
United States	Deep-water	57	
	Shale	73	12
Angola	Offshore	40	NA
Ecuador	Total	20	NA
Venezuela	Total	20	NA
Kazakhstan	Total	16	NA
Nigeria	Deep-water	30	NA
	Onshore	15	NA

Oman	Total	15	NA
Qatar	Total	15	NA
Iran	Total	15	NA
Algeria	Total	15	NA
Iraq	Total	6	NA
Saudi Arabia	Onshore	3	2
Source: https://public.knoema.com/tldwcyc/cost-of-oil-production-by-country			

Table 1 shows the marginal cost of oil production for the main producers. It is immediate to observe that Middle East countries, having the lowest cost will be the latter to abandon production and feel the burden of decarbonization.

Downstream revenues are collected when the natural resource is used for consumption or production. The specific instrument is excises, i.e. specific taxes usually levied on quantities.[i] Under the current practice worldwide only fossil fuels are subject to specific taxes while the use of minerals is only subject to general sales taxes as every other item.

Downstream taxes on fossil fuels are much higher in the nonproducing countries than in the producing countries. In the latter, low taxes are a way to share directly with the population the benefits derived from the location of the resource within the territory.

Summing up, provided that countries are engaged on the decarbonization path, ie. they proceed to reduce the use of fossil fuels and increase alternative clean sources of energy.

The revenue net impact is as follows:

$$Rn = Gut - Lut + Ldt$$

Where:

Rn: revenue net impact

Gut: (Potential) gains of revenues from upstream taxes on minerals and rare earths

Lut: Losses of revenue from upstream taxes on fossil minerals

Ldt: losses of revenues from downstream taxes on fossil fuels.

In principle, the quickest way to the disappearance of the use fossil fuels would be to raise the downstream excises on them. The ensuing reduction of demand will produce a corresponding decrease in the production, hence of the international price and, consequently of the producer rent. This implies that consuming countries, most obviously the consuming and non-producing countries could lead the decarbonization process, reducing the tax base for upstream taxes and increasing the tax base for downstream taxes that they could use to their benefit,

Several risks surround the decarbonization process and the ensuing fiscal impact. Countries could delay their exit from fossil fuels and/or proceed with slow speed on the development of alternative sources of energy. There are also risks deriving from the choice of technology, such as an example, those referred to as the so-called «chemistries» in cathode batteries. The resurgence of LFP (lithium-based batteries) and shifting of NMC (nickel, manganese, and cobalt-based batteries) towards chemistries using less cobalt has brought a rapid demand for lithium and a smaller demand for cobalt with an immediate reflection of price and production. A variety of technologies eases concerns about supply but increases uncertainty about the profitability of investments and impact on the country/ local economy and finances leading to fluctuating prices.

A look at the actual dimension of the issues: the samples

We now proceed to the observation of the prospective impact of decarbonization for three distinct samples of cases. The first one is made by fossil fuels heavily dependent countries. The second one includes the largest Latin American countries. The third one looks at subnational governments in Bolivia.

For each of these groups of countries, or of governments, the available information is represented graphically. Figure 1 shows the fossil fuels heavily dependent countries. These countries are ranked according to the dependence of their GDP on rents. As we saw, the rent is the basis on which the taxes can be levied. The degree of dependence reaches astonishing sizes. In more than half of the countries in Figure 2 fossil rents exceed twenty percent of GDP, meaning at least that the abandonment of fossil fuels would require a huge, costly, and risky diversification process of the economy. Since fossil fuels are practically the only source of fiscal revenue, the diversification process would have to be financed by other, new, sources. This explains the strong resistance by these countries to accept a scenario implying the final elimination of the use of fossil fuels.

Happily, decarbonization provides not only losses but also perspectives of gain. These are illustrated in the right-hand side of the figure that reports the potential gains for countries deriving from the availability of critical minerals. Cells filled with an x indicate that the concerned country is among the ten top producers of the listed mineral.

Figure 2. Fossil fuels heavily dependent countries

	Prospective loss	Potential compensation available to major producers of critical minerals																					
	Fossil fuels rents as % of GDP	Bauxite	Cadmium	Cobalt	Copper	Chromium	Tin	Galium	Germanium	Graphite	Indium	Lithium	Manganese	Molybdenum	Nickel	Silver	Lead	Selenium	Silicon	Tellurium	Rare earths	Titanium	Zinc
Timor Leste	57,4																						
Kuwait	38,6																						
Iraq	37,2																						
Lybia	34,8																						
Congo DRC	29,2			x	x																		x
Oman	24,6																						
Saudi Arabia	24,4	x																					
Equatorial Guinea	22,1	x																					
Azerbaijan	21																						
Brunei	19,9																						
Qatar	19,3																						
Angola	17,9																						
Turkmenistan	17,6																						
Iran	17,4													x			X						
Algeria	15,2																						
Gabon	14,9												x										
Uae	14,6	x																					
Chad	13,5											x											
Kazakhstan	12,6	x	x		x	x							x						x				
Venezuela	11,7																						
Russian Federation	10,5	x	x	x	x		x	x	x	x		x		x	x	x	x	x	x	x	x		x

South Sudan	8,5																					
Mongolia	7,9																					
Trinidad Tobago	7,2																					
Papua new guinea	7,2		x																			
Uzbekistan	6,9	x							x	x			x						x			
Nigeria	6,6																					x
Norway	6																					
Mozambique	6																					
Ecuador	5,3																					
Suriname	4,7																					
Malaysia	4,6											x						x				x
Egypt	4,6																					
Bahrain	4																					
Colombia	3,7																					
Ghana	3,1											x										
Bolivia	3					x					x				x	x					x	x
Yemen	2,9																					
Cameroon	2,8																					
Sudan	2,4																					

Sources: Authors' elaborations from: UNDP (Lars Jensen), Global Decarbonization in Fossil Fuel Export-Dependent Economies. Fiscal and economic transition costs. 2023; U.S. Department of the Interior U.S. Geological Survey Mineral Commodity Summaries, 2023.

Cells marked in blue refer to the minerals most pressing in need.

The right side of the table, the compensation side, has a lot of void cells, meaning that a substantial possibility of compensation is concentrated in very few countries. Some cases are just dramatic. Can we, for example, imagine Iraq without the revenues provided by oil?

Diversification would impact negatively the present standard of life of very dependent countries, making international support necessary, also because wealth sovereign funds, which could finance the transition, are concentrated in very few, rich countries.

The second, Latin America-focused sample follows in Figure 3. Data is more complete because it includes also downstream taxes that were not available for the first sample. The red column shows the full loss from decarbonization. The table presents a more balanced picture. Only Venezuela is going to lose very substantially. Many countries have large reserves of critical minerals. One of them Bolivia has, as we saw, enormous reserves of lithium.

Figure 3. Prospective losses and potential gains from decarbonization in Latin America

Revenues lost to decarbonization					**Potential compensation to major producers of critical minerals**																					
	Upstream taxes on fossil fuels, as a share of GDP	Downstream taxes on fossil fuels, as a share of GDP	Total upstream and downstream taxes on fuels, as a share of GDP	Upstream taxes on minerals, as a share of GDP	Bauxite	Cadmium	Cobalt	Copper	Chromium	Tin	Galium	Germanium	Graphite	Indium	Lithium	Manganese	Molybdenum	Nickel	Silver	Lead	Selenium	Silicon	Tellurium	Rare earths	Titanium	Zinc
Argentina	0,5	1,18	1,68	0,1											x				x							
Bolivia	3,9	-0,6	3,3	0,8						x					x				x	x					x	x
Brasil	1,02	0,93	1,95	0,3	x					x			x		x	x		x				x		x	x	
Chile	0	0,42	0,42	1,8				x									x		x							
Colombia	1,7	-0,06	1,64	0,3																						
Ecuador	8,3	-2,18	6,12	0,1																x						
México	1,6	0,49	2,09	0,2		x		x					x			x			x	x					x	x
Perú	0,5	0,41	0,91	1		x				x				x			x		x		x					x
Venezuela	11,7		11,7	0,1																						
Uruguay	0	1,49	1,49	0																						
Paraguay	0	0,99	0,99	0																						

Sources: Authors' elaborations from: UNDP (Lars Jensen), Global Decarbonization in Fossil Fuel Export-Dependent Economies.

Fiscal and economic transition costs. 2023.; Juan Pablo Jiménez y Andrea Podestá Los recursos fiscales derivados de hidrocarburos y minerales en América Latina. Desafíos ante la imprescindible descarbonización y transición energética. Working Paper 2023; US. Department of the Interior U.S. Geological Survey Mineral Commodity Summaries, 2023.

It provides a good introduction to the subnational impact of decarbonization because present rents from fossil fuels are very spatially concentrated as well as future potential gains. However, there is no correlation between the two cases.

Figure 4. Bolivia. Departments and municipalities

Revenues lost from decarbonization (percapita US $)					**Potential compensation from critical minerals**				
	oil and gas rents upstream	oil and gas royalties upstream	oil and gas excises	% share of oil & gas rents on GDP	mining royalties	lithium reserves	revenue sharing	per capita GDP.	population
bení	91,1	34,5	11,3	5,7	1,2		115,0	2.406	480.000
cochabamba	27,4	2,9	5,0	1,2	0,2		113,6	3.049	2.029.000
chuquisaca	68,7	58,9	9,4	4,0	0,6		119,3	3.433	637.000
la paz	29,8	0,0	4,6	0,9	3,0		127,9	4.023	2.927.000
oruro	79,4	0,0	10,3	2,3	5,1		117,3	3.970	551.000
pando	284,1	53,8	28,2	14,3	0,6		93,7	2.555	154.000
potosi	48,5	0,0	7,6	1,8	23,1	xxx	120,1	3.079	902.000
santa cruz	20,1	30,4	4,0	1,4	0,2		103,1	3.966	3.370.000
tarija	75,1	235,9	9,7	6,3	0,0		108,5	5.072	583.000

Sources: Authors' elaborations from: UDAPE Dossier de Estadísticas Sociales y Económicas Volumen 32; Ministerio de mineria y metalurgia. Anuario Estadístico y Situación de la Minería 2022; Población y distribución de recursos fiscales. Desarrollo Sobre la Mesa https://inesad.edu.bo/dslm/2013/07/895/

Figure 4 provides quite detailed information. In addition to upstream and downstream revenue from fossil fuels, it shows also the revenue from upstream taxes on minerals, the mining royalties. This latter revenue would persist in case of decarbonization and would be expanded by the increased demand for critical minerals, specifically lithium. Interestingly, the department of Tarija (the figure has data that pertains to the government of the department aggregated with data about the municipalities included in the area) which is presently the great beneficiary of the oil and gas bonanza will be left with no natural resource revenue. One department, Potosì, would gain enormously from lithium which will add to already substantial mining royalties. Three departments (those in green in the figure) would maintain gains and five departments (those in yellow) would lose mostly from the disappearance of downstream taxes on fossil fuels and will have no gains from the critical minerals.

The Bolivian numbers provide a good case for rethinking the whole issue of the intergovernmental sharing of natural resources revenue. The table provides some relevant information for those readers who would like to start some simulation exercises. The two columns at the right show per capita GDP and population. The distribution of GDP leads to examining the equity issues of the present situation and shows the direction for future changes. Population, especially when coupled with GDP shows the likely cost of compensatory and redistributive measures. Overall, the Bolivian case shows the need of reconsidering the whole system of financing subnational governments with a view to more equity and long term sustainability.

Conclusions

There are no easy conclusions, but to propose that countries concerned with these changes, and also the international community, start elaborating long-term and short-term strategies. Long-term strategies have by definition a time horizon of several decades (generally 10 to 30 years). They are based on assessing the economic size of the natural resources, the evolution of prices, and the effects of longer-term trends with a significant fiscal impact, like decarbonization, demographics, technological change, etc.

A cornerstone of a long-term strategy is economic diversification. Oil and gas-producing countries have a comparative advantage in related sectors, but because of phasing out this diversification is not an option.

Defining a trade-off between the present and the future generations is also crucial, assuming that the present standard of consumption and production are unsustainable. For example, should countries maintain present standards of living, or allow a temporary fall to start diversification? Or should they save in physical capital, according to Hartwick rule, or similar rules, or focus on directing savings to sovereign funds?

Short-term strategies apply also inside single countries, i.e. subnational governments. At this level, they should consider compensation of losers through equalization, or other grants, or assignment/sharing of tax revenues. These policies are feasible but constrained by the erosion of revenues. Changes in the spatial allocation of resource revenues are in principle feasible, but politically arduous.

Compensation between countries is a task for the international community. »Gainers/losers funds», are feasible when targeted to small nations. They become very problematic for large nations, but they are needed.

Global exports draining local water resources: land concentration, food exports and water grabbing in the Ica Valley (Peru).

By Andrea Pronti, Eduardo Zegarra, Dolores Rey Vicario and Anvil Graves[3]

Global agricultural trade and export specialization has transformed the geography and the economy of many low-middle income countries, which have become major players within global food value chains. One of these is Peru, which is now a global leader in the export of water-intensive crops such as asparagus and grapes, at the expense of scarce water resources and with a heavy reliance on groundwater (Salmoral et al., 2020). Whilst this agro-export boom has supported employment, rural development and economic growth for some people, significant social and environmental challenges for others limit its sustainability. In particular, heavy abstraction for irrigation is likely to increase pressure on groundwater reserves, particularly given the ever increasing demand for water intensive export crops (Schwarz and Mathijs, 2017). One of the areas where these conflicts are starting to manifest is the Ica Valley in Peru, which after liberalisation of the agricultural land market has seen large agricultural corporations focused on international crop production (mainly asparagus, grapes, onions and avocados) acquiring large areas of land from smallholders (Williams and Murray, 2019). These corporations have developed large areas of intensive irrigation leading to prolonged water crisis for other stakeholders (Muñoz, 2016; Schwarz and Mathijs, 2017; Williams and Murray, 2019). Whilst drip irrigation systems have been deployed to increase productivity, the high value of the crops produced has led to a 'rebound effect' (Berkhout et al., 2000; Sorrell and Dimitropoulos, 2008) since the water savings obtained have encouraged expansion of the irrigated area for high value crops, such as asparagus and grapes, increasing the overall withdraw of groundwater rather than conservation of the water resource itself (Berbel et al., 2015; Berbel and Mateos, 2014).

Based on the findings from Salmoral et al. (2020), this paper aims to examine what factors are driving the unsustainable use of groundwater in the Ica Valley and what implications this has for sustainable development in the area by applying an econometric approach.

Our dependent variable is the sustainability of groundwater use in each tract measured with the Groundwater Sustainability Index (GWSI) based on the approach of Salmoral et al. (2020). The index shows the ratio between the level of groundwater used for irrigation that is not covered by natural water recharge over the total groundwater used for irrigation for each area. Our unit of observation is the census tract level with an unbalanced panel of 130 observations (2015 to 2018).

We focus on three key drivers: i) the expansion of drip irrigation measured by calculating the annual ratio of drip irrigation over the total irrigation per census tract in each year, ii) the specialization in exporting crop commodities identified by determining whether the cultivation of export-oriented crops (avocados, asparagus, grapes, onions or pecan nuts) in the tract was greater than 70% of the total cropped area of the tract in each year; and iii) the concentration of land by big exporting farms measured as the ratio of the cropped area of large farms to the total cropped land of the tract in each

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year. Moreover, we used socio-economic and average climatic conditions (i.e. rainfall and temperature) as controls.

Since our dependent variable is bounded between 0 and 1, we used both the two-limit Tobit model, (Wooldridge, 2010) and the fractional model of Papke and Wooldridge (2008, 1996). Moreover, we controlled for unobserved heterogeneity using a correlated random effect model as in Wooldridge (2019, 2010), Shunck (2013) and Arslan et al. (2014).

The results of our analysis indicate that: a) the extension of drip irrigation as a share of total land reduce GWSI; b) higher level of specialization in exporting commodities affect negatively GWSI; c) the proportion of large farms in tract reduce the level of GWSI.

Furthermore, we repeated the econometric exercise focusing only on the two most important export crops in the area grape and asparagus. Our findings support that specialization grape reduce GWSI, whereas we did not find statistically significant effect of tract specialization in asparagus on GWSI.

These results are in line with previous studies on the sustainability issues of agricultural development in the area (Boelens et al., 2014; Chiarelli et al., 2022; Dell'Angelo et al., 2021, 2018, 2017; Franco et al., 2014). The proliferation of large farms focused on the production of agroexport commodities increases the level of groundwater extraction which does not return to the aquifer due to the intensification of drip irrigation. Highly efficient irrigation technologies (drip) produce an intensification and expansion effect on users which causes additional overall demand on natural resource causing a general over-use of water at regional level. This is a clear example of the "rebound effect" due to the commodification of the area, which on one hand is creating job opportunities, local development and economic growth but on the other hand is depleting water resources, so crucial for the local economy. Moreover, land use specialization in export crops is an evident factor influencing unsustainable water use due to a high level of groundwater extraction.

Groundwater resources extracted from the Ica-Villacuri aquifer are "transformed" into agricultural commodities which are then exported abroad as "virtual water". Also, most of the value created in the value chain (logistics, transport, marketing and retailing) is captured abroad and the return on the capital invested by large farms is "exported" abroad, as most large farms have a financial base in western countries (Borras et al., 2020, 2012a, 2012b). The Ica Valley is therefore participating in the global value chain, via its natural capital, but with low levels of return, whilst conversely, its groundwater is undergoing increasingly high levels of marginal depletion as the profitability of the regional agricultural market grows.

The current development path of the Ica Valley is a clear "win-lose" situation with divergent interests (local vs global and public vs private) and exposes the local economy to international trade through groundwater use. The water management institutions need to intervene with remedial actions, in particular, to reduce over-exploitation of groundwater using policy tools, such as water prices, local water markets, or water withdrawal permits to reduce groundwater abstraction. In combination with these policy measures, additional infrastructure, such as small dams or artificial water basins could be established to reduce pressure on water resources.

The situation of the Ica Valley as shown in this paper is similar to other studies dealing with Large Scale Land Acquistions and 'water grabbing' such in the studies of Raimondi and Scoppola (2022), Chiarelli et al. (2022), Dell'Angelo (2018, 2017) and Wegenast et al. (2022).

This is a challenge affecting many countries in Latin America and not just Peru and the Ica valley. The findings from this work help to understand the factors promoting unsustainable agricultural expansion in developing countries. The Ica Valley is an example of a wider international pattern of trade, which exploits territories and natural resources in less developed countries, and we strongly believe that this area of research should be further explored.

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The indispensable role of industrial policy: the case of the Chinese EV industry.

By Xieshu Wang[4]

Introduction

China is the only country that has so far developed a full value chain of electric vehicle (EV) manufacturing, from raw material production, battery making, EV assembly to end-of-life recycling. It's largely the merit of strong and comprehensive industrial policies, covering multiple aspects from raw material management, general emission standards, EV technical requirements, taxation exemptions, practical advantages to charging infrastructure, public fleet, demonstration zones, etc. These policies have evolved with the market status, following the Chinese way of 'learning from experimentation' (Roland, 2000; Qian, 2002; Wang and Yang, 2023), constantly adapting to changing situations. Industrial data about the Chinese EV market's different dimensions illustrate how effective the EV industry policy has been. To better understand the indispensable role of the industrial policy, we need to trace the origin of China's EV industry policy and analyse the different types of measures adopted at different government levels. We see that the industrial policies have gone through several phases, showing important changes and evolutions, with the goal to not only reinforce China's leadership in the emerging global EV industry but also accelerate the decarbonisation of its economy.

Impressive growth of EV production and consumption in China

China has become the world's leading EV production and consumption country in 2015 and has continued to be so since then (see Figure 1). For the year 2023, about 9.5 million units of EVs were sold in China, representing about 32% of total new car sales and showing a growth rate of 38% on a year-to-year basis; among them 7.7 million units were passenger EVs, indicating the dynamic market demand from private sectors (CAAM). In comparison, the estimations for passenger EV sales in Europe and in the North America in 2023 were respectively 3.3 million and 1.6 million units (O'Donovan, 2023).

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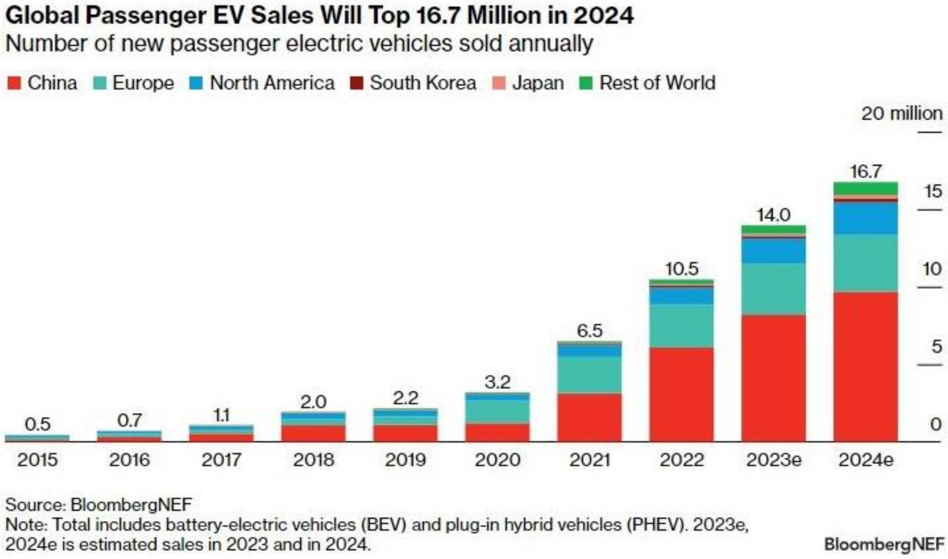
Figure 1: Annual global passenger EV sales



In fact, the take-off of the Chinese EV industry hasn't been an easy endeavour. Although China has already identified the EV industry as a future strategic sector back in the 1990s (Gong et al., 2013), the lack of key technologies and key components production capacity has delayed the real progress. Yet, under strong policy orientation, both public and private sectors have continued to invest massively in the industry, and a series of R&D programmes and collaborations dedicated to EV were funded, gradually building manufacturing capacity and purchasing necessary technologies and savoir-faire to make the wheel run. As a decisive move, in 2009, the Chinese central government has announced the first explicit industry policy in support of the local deployment of EV in selected pilot cities. In parallel, regulations regarding EV production's efficiency and technology standards were released regularly to provide guidance to industrial actors and investors.

Since 2015, China has seen an impressive fast growth in the domestic EV production and sales and has become the largest EV producer and consumer market in the world (see Table 1). In recent years, the EV sector has made significant contributions to the growing auto exports of China. In 2023, China has taken over Japan, becoming the world's largest auto exporter.

Table 1: Chinese auto/EV production and export

Unit: million	Total Production	Total export	EV production	EV Export
2023H1	13.25	2.34	3.79	0.8
2022	27.02	3.11	7.06	1.12
2021	26.08	2.01	3.54	0.59
2020	25.22	0.99	1.36	0.22
2019	25.72	1.02	1.24	0.25
2018	27.82	1.04	1.27	0.15

Source: CAAM

A comprehensive package of EV industrial policies

China's industrial policy aimed at building the technology supremacy in the EV manufacturing and nurturing a completely self-controlled EV supply chain has started to brew in the 1990' and finally took form in the late 2000'. Its objectives also include mitigating environmental problems mainly in big cities and reducing oil import dependency. During the 'Tenth Five-Year Plan' period (2001-2005), China implemented the 'Major Science and Technology Project for Electric Vehicles' (863 Plan), forming an overall new energy vehicle technology roadmap. Since 2009, a series of monetary and non-monetary measures have been taken by the central and local governments to incentivise the take-off of local EV markets, expanding very soon from pilot cities to the whole nation and from public sectors (buses, taxis, city sanitation, postal trucks and government officials' vehicles) to various private application scenarios (family usage, corporate fleet, logistic vehicles, car-sharing).

In 2009, as a decisive move in promoting local EV adoption, the national government launched the 'Ten cities, thousand vehicles' programme (Ministry of Finance, 2009), which had been expanded to 25 cities by August 2010. In 2010, measures providing purchase subsidies for private passenger cars were also announced (Ministry of Finance, 2010). In 2012, the State Council released the 'Energy-saving and New Energy Automotive Industry Development Programme (2012–2020)', which included supporting policies such as purchase subsidies, technical requirements for EV such as energy consumption efficiency, and directives for the promotion of charging infrastructure, as well as set a target of five million cumulative sales of EVs by 2020 (State Council, 2012). This has become the foundation of the Chinese government's industrial policy for the next decade.

The central and local governments have different roles in the policy implementation: the central government's role was to provide national purchase subsidies and guidance on technological and emission standards; local governments' role was to provide local purchase subsidies, fund the charging infrastructure and manage local implementation (Gomes et al., 2023). In particular regarding managing local implementation, each local government has certain autonomy in deciding the concrete measures of incentives and their extent. In addition to the national purchase subsidy granted by the central government to a legitimate EV model, a local government could provide another purchase subsidy at no more than 60% of the national one. To further promote EV sales, local governments also offer many practical advantages to EV owners, such as priority registrations, unlimited road access, charging fee incentives, parking fee incentives, and highway tolls exemption. Related research shows that these practical advantages have been important drivers for EV purchase in major Chinese cities, as many of them have very limited new plate release and travel restrictions on traditional internal combustion engine cars, and incentives on charging and parking have a long-term positive impact on EV sales (He et al., 2018; Liu et al., 2023; Zhang, 2024).

An adequate charging infrastructure is a key barrier for the fast adoption of EVs. Ever since the beginning, the promotion of charging infrastructure has been highly strengthened in the EV industrial policies in China. The national directive released in 2016 announced that one city can apply for up to 120 million RMB in funding for charging infrastructure construction. In the policy implementation, many provinces and municipalities have adopted their own measures to provide incentives for building and operating charging points locally. For example, in March 2020, the city of Guangzhou announced its subsidy funding measures for EV charging infrastructure as follows: 1) charging infrastructure construction: for DC charging piles, AC-DC integrated charging piles and wireless charging facilities, a subsidy of 300 RMB/kilowatt is calculated based on the project size; for AC charging piles, the subsidy standard is 60 RMB/kilowatt; for battery swap facility, the subsidy standard is 2,000 RMB/kilowatt; 2) charging infrastructure operating: for dedicated and public charging facilities, a subsidy of 0.1 RMB/kWh is provided, within a maximum number of hours (2000 hours/year for charging stations and 3000 hours/year for battery swap stations). By the end of 2022, China has built over 5 million charging stations, reaching a EV-charging ratio at 2.5:1. And the number is growing even faster since 2023. Data published by the National Development and Reform Commission (NDRC) in July 2023 indicated that by the end of June 2023, the cumulative charging stations in China reached 6.6 million.

For the OEMs, the most important policy is the technical requirements to legitimate a NEV model for the direct financial subsidies. The central government has continued to raise the standard of technical requirements: they were extended from the simple driving range at the beginning to now including also battery efficiency measurement, vehicle energy consumption level, charging standards, etc. Based on technical requirements, every year there is a public catalogue of NEV models qualified for the direct purchase subsidies. When consumers purchase a subsidised model, they will be refunded a certain amount of the invoice depending on the model's technical features (there is a specific calculation formula). NEVs models not satisfying the technical requirements are not listed in the catalogue thus not legitimate to receive direct subsidies. By designing and monitoring the technical aspects of the major EV models, the Chinese government has provided incentives for EV makers to constantly improve their manufacturing technology and efficiency.

China has invested a lot of financial resources to accelerate the take-off of the domestic EV market. It's estimated that, from 2009 to 2021, the cumulative purchase subsidies for NEVs (new energy vehicles, including electric vehicles and fuel-cell vehicles) from the central and local governments amounted to approximately 200 to 250 billion RMB (Zhang, 2023). To further provide financial incentives for purchasing NEVs, the Chinese government has adopted several tax exemption policies: from the beginning, there was no car consumption tax on NEVs; since 2012, battery EVs (BEVs) are no more subject to annual vehicle and vessel tax; since September 2014, vehicle purchase tax has also been exempted for NEVs. From January 2012 to June 2023, the cumulative vehicle and vessel tax exemptions for NEVs reached 10 billion RMB; from September 2014 to June 2023, the cumulative purchase tax exemptions on NEVs exceeded 260 billion RMB, of which almost 50 billion RMB happened in the first half of 2023 (China Daily, 2023).

Purchase subsidies and tax exemptions have certainly been important drivers for the Chinese consumers to switch to the electrified mobility. The favourable financial and market conditions have allowed the Chinese EV makers to fast scale up their production capacity, multiple new EV models and reduce significantly the EV prices. With the maturating of the domestic EV market and the increasing competitiveness of Chinese EV brands, the Chinese government has started to change the policy measures, from direct financial subsidies to more market-driven mechanisms. The year of 2016 marked the beginning of the phasing-out of EV purchase subsidies from the central government; from 1 January 2023, no more purchase subsidies will be granted by the central government. Yet, local governments still have the right to provide a certain amount of purchase subsidies. In the same time, the tax exemptions are prolonged to at least 2027.

A more important evolution of the EV policy is to substitute the direct financial subsidies with a market-based NEV credit system; together with the pre-existing fuel consumption requirements, known as corporate average fuel consumption (CAFC), they form the so-called 'dual credits management system'. The 'New Energy Vehicle Mandate' that came into force on April 1, 2018 imposed NEV credit targets as 10% of the conventional passenger vehicle market in 2019 for any carmaker with over 30,000 vehicles manufactured locally or imported yearly in China (gradually increasing to 12%, 14%, 16% and 18% in 2020, 2021, 2022 and 2023). The NEV credit, in the case of BEV, is calculated based on driving range, energy density coefficient and power consumption coefficient, with a limit of maximum points. The CAFC is calculated based on vehicle kerb mass: a company can earn credits if its current annual CAFC is lower than the CAFC target; its design is learnt from California's zero-emission vehicle regulations. The first phase of China's CAFC standard started in 2005 with a series of regulations to improve vehicle fuel efficiency. For the current phase 5 (2021–2025), the target is 4.0 L/100 km. This way, the government will no longer bear the financial burden; instead, OEMs will have to invest in R&D to improve the fuel efficiency of their vehicles or buy credits from other OEMs to avoid penalties if the CAFC and NEV credit targets are not met.

From the perspective of policy mechanism, the dual credit management system is an institutional attempt to establish a market-oriented mechanism for the coordinated development of energy-saving and NEVs. Since its implementation in 2018, the Ministry of Industry and Information Technology (MIIT), together with the four departments, has organised five credit transactions, with a cumulative transaction amount of more than 25 billion RMB. The dual credit management system has also gone through several adjustments, as the Chinese NEV market has gradually shifted from policy-driven to market-driven, with more and more consumers actively switching from traditional fuel vehicles to NEVs.

A very good example of how the Chinese government tailors an explicit industrial policy to support the growth of the national EV industry is the measure of 'whitelist' for battery makers. The leading Chinese EV battery firms are now among the largest producers in the world; but it did take time for them to grow big and competitive, able to challenge their Japanese and South Korean peers. Back in 2016, to exclude foreign competitors and protect its nascent lithium-ion battery industry, the MIIT introduced the catalogue of 'Regulations on the Standards of Automotive Power Battery Industry' (commonly known as the 'whitelist'). Only battery models fully owned by domestic battery makers were listed, and hence eligible for government NEV subsidies. This measure temporally chased Japanese and South Korean battery firms out of the Chinese local market and gave Chinese firms a time window to build their own comparative advantages (Wang et al., 2022). With the Chinese EV battery sector becoming technologically and economically competitive, and also starting to face overcapacity issue, the Chinese government has reopened the domestic market in 2018, inviting market forces to drive the industrial consolidation. Although disputable as a protectionist measure, this episode is a perfect demonstration of the dynamic way of policy making in China.

In 2020, the central government has further strengthened the crucial role and a continued support of the auto industry by publishing its guidelines in the "New energy vehicle industry development plan (2021-2035)". The 2021-2035 Plan proposes that by 2025, the average power consumption of new pure electric passenger cars will be reduced to 12.0 kWh/100 kilometres, the sales of NEVs will reach about 20% of the total new car sales (which was already achieved in 2022), and highly autonomous vehicles will be implemented in limited areas and in specific scenarios for commercial applications. By 2035, pure electric vehicles will become the mainstream of new sales; public sector vehicles will be fully electrified; fuel cell vehicles will be commercialized; and highly autonomous vehicles will be applied on a large scale, effectively promoting energy conservation, emission reduction, and social operation efficiency.

Conclusion: EV industry at frontier of multiple transitions

The transition from traditional transport towards low-or zero-emission modes of transport cannot be left to technological roadmaps and market coordination alone, but depends on a more comprehensive policy to steer the electrification of the automotive industry on to a greener, more efficient and socially inclusive track (Pardi, 2021). We see that the EV industrial policies in China have gone through several phases, showing important changes and evolutions, with the goal to not only reinforce China's leadership in the emerging global EV industry but also accelerate the decarbonisation of its economy.

Under the support of a comprehensive package of industrial policies, a dynamic and competitive domestic EV industry has formed and become the basis for the future development of sustainable and intelligent mobility in China. In the same time, the industrial supply chain of EV industry is extremely long and complex; the Chinese government continues to design, monitor and adjust related policies, such as regarding the upstream raw material supply or the downstream end-of-life vehicle treatment and battery recycling. In particular, with the increasingly stringent global requirement on low-emission standard and carbon footprint certificate, the whole automobile industry must reform its growth strategy. The EV industry is just at the frontier of multiple transitions which advocate for renewable energy sources, sustainable, circular and shared economy models, and smarter management platforms and systems. To make these transitions smooth and effective, relevant industrial policies will become even more important and need to take into consideration more stakeholders and full impact.

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Effects of industrial policies for energy transition on emerging countries.

by Augusto Ninni[5]

As energy accounts for around 2/3 of GHG (greenhouse gases) emissions, we focalize our analysis about the effects of mitigation policies against climate change on energy, particularly electrical energy: so our key issue is energy transition.

The energy trilemma

Since few years the choice between energy sources and more generally energy policies are influenced in most countries by the *energy trilemma*[6]. That means the design and the assessment of national energy policy must take into account – possibly in the same time - three main issues: affordability-sustainability-reliability.

Affordability means taking into account the cost of energy sources. Even if energy expenditure does not represent the highest cost item for every industry[7] it affects every of them, so that its total weight is very relevant. So, one of the most important changes in the very recent years is the cost reduction of the renewable energies, at least in the generation of electrical energy, to levels lowest than the fossil fuels to make them competitive with the fossil fuels, removing the "grid parity" issue.

Sustainability means considering GHG emissions. There is no doubt that there are strong differences between renewable sources (where emissions are practically zero) and fossil sources, where coal is known to be the most polluting source. This difference is also confirmed if we take into account emissions related to the entire product life cycle, i.e. considering the stages of production of raw materials and semi-finished products, manufacture of components, and then waste disposal.

Reliability means reducing dependence on foreign sources, both for the final product and for upstream stages. The incidence of this argument is strongly increasing in very recent times[8] after the Russia-Ukraine war, but it is affecting also the future of the energy transition, give the absolute supremacy of China in the PV (photovoltaic) industry. Its share in the world solar panel exports is more than 70 % while - according to IEA (International Energy Agency) - its production capacity overcomes 90 % of the world total for some components of the PV chain. Less known is the evolution of the Chinese firms in the world industry, moving from 2009 (when the domestic demand accounted around for 5% of its capacity) to 2022 (where eight top companies on ten are Chinese (table 1).

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[6] It is an approach institutionalized at the time by the World Energy Council, a long-standing international association of energy experts.

[7] Of course with the exception of the energy intensive industries.

[8] The strategic factor was very important also in the past: the increasing weight of the European investments in the nuclear energy started with the first crisis of the Suez channel (1956).

TAB. 1 - The top 10 photovoltaic companies in the world, in terms of quantity sold.

2009	2014	2019	2022
First Solar (USA)	Trina (China)	Jinko Solar (China)	Longi Green Energy (China)
Suntech (China)	Hanwha (Korea)	JA Solar(China)	Jinko Solar (China)
Sharp Solar (Japan)	Yingli (China)	Trina (China)	Trina (China)
Yingli (China)	NeoSolar (Taiwan)	Longi Solar (China)	JA Solar (China)
Q Cells (Germany)	Jinko Solar (China)	Canadian Solar (China)	Canadian Solar (China)
JA Solar (China)	First Solar (USA)	Q Cells - Hanwha (Germany - Korea)	Risen Energy (China)
Trina (China)	Motech (Taiwan)	Risen Energy (China)	Astroenergy (Chint Group) (China)
Sun Power (USA)	Hareon (China)	First Solar (USA)	First Solar (USA)
Kyocera (Japan)	Canadian Solar (China)	GCL (China)	Q Cells - Hanwha Solutions (Germany - Korea)
Motech (Taiwan)	Gintech (Taiwan)	Shunfeng Photovoltaic (China)	DMEGC Solar (Hengdian Group) (China)

Sources: for 2009 and 2014 Renewable Energy World; for 2019 SolarQuotes; for 2022 Pv-Tech

Industrial policies of US and EU

So, US and EU are developing their own industrial policies[9] to support inside energy transition also by trying of reducing their dependence on China.

A few months after the invasion of Ukraine, in August 2022 Biden's United States launched the *Inflation Reduction Act* (IRA), a vast intervention programme: one of the aims of which was to facilitate the development of renewable energies while adding the strategic objective of reducing economic dependence on foreign countries, not changing too much the approach followed at the time by Donald Trump.

IRA is one of the best examples of how it is possible to reduce (and strongly) the emissions of the production system while at the same time favouring employment and productive development, so as to dispel that negative image of lowering social welfare with which energy transition is sometimes presented. In the IRA, out of an intervention programme worth 499 billion dollars (over ten years,

[9] Industrial policies connected with energy policies, aiming at managing the last in order to improve at least competitiveness, are not unknown: remember at least the examples of France (nuclear energyr) and Germany (*Energiewende*).

with an equal share year by year), 'climate and energy' counts for 391 billion, of which 41% for renewable energies and 9% for electric vehicles, in the form of tax credits and subsidies, providing some “protectionist” measures, based on local content requirements (LCR).

For example:

- «clean energy sources»: tax credits are increased by 10% if made in North America steel and other components are used
- Electric vehicles: customers can receive credits only if vehicles utilize some percentages of materials and components, or parts of batteries coming from US (or countries with foreign change agreements).

The main critics are that LCR attracts foreign investments (and discourage US firms to go abroad); furthermore, LCR is against WTO (World Trade Organization) rules[10].

Less than one year after the IRA, the European Commission proposed a plan to facilitate the development of renewables: here too, paying particular attention to reducing dependence on foreign countries (and China in particular), albeit in a different form from the IRA approach, but also responding to the increased attractiveness of locating these plants in the USA, due to the “appeal” of the IRA protectionist measures.

The name of the EU proposal[11] is the *Net Zero Industry Act* (NZIA). The NZIA proposal is less generous[12] than the IRA in terms of funds, and probably less realistic in terms of objectives (it aims to reach self-sufficiency of 40 % by 2030 in clean technologies).

In terms of reliability, it introduces the concept of strategic dependence (if supply concentration from a foreign country is around 65, to lower to 50% in some cases) to be utilized in auctions and Government Public Procurement of components for clean energy.

So the main difference is clear: for the reduction of the dependence from abroad IRA utilizes a sort of Buy American approach (albeit for some components plus EV and batteries), while NZIA does not utilize a Buy European approach, as it prefers to look at the concentration of supply.

Effects on emerging countries

Energy transition (from fossil fuels to renewables energy sources, RES) affects the industrial features of the emerging countries mainly in two, interconnected but different, ways:

- The inside manufacturing for RES, which derives from the industrial policy of the country also in order to achieve its NDCs (Nationally Determined Contibution);

[10] However we must take into account the refusal of the Biden Administration to nominate US delegates in the Appellate Body of WTO, so WTO meets some difficulties to work out.

[11] In October 2023 approved also by the European Parliament: the European Council has not yet discussed it.

[12] According to Gregory Claeys' first comment, 2023: the additional lack - in terms of available funds - of the NZIA is due to the 'political' characteristic of the act, i.e. it is proposed to please some countries, while the lack in terms of disbursements serves to please other countries.

- The amount of exports of components for RES, which is influenced by possible use of local content and other clauses of commercial policy, deriving from the industrial policies of other countries.

The first way is rather simple to assess. We looked at the plans of industrial policies of some Asian and African emerging countries (as they are summarized in English), searching where the term "manufacturing for renewables" is officially mentioned between strategic industries for the current or for the future times, and where the term "photovoltaic" industry is explicitly utilized among them (see Table 2).

The result is straightforward: all the considered countries mention both "manufacturing for renewables" and "photovoltaic" as a part of the development plans, Egypt being the only exception.

TABLE 2 – "MANUFACTURING FOR RENEWABLES" AND "PHOTOVOLTAIC" TERMS IN THE INDUSTRIAL PLANS OF EMERGING COUNTRIES

	Manufacturing for Renewables as a strategic industry	**Photovoltaic**	**Explicit import limitations (local content and other)**
China	v	V	
Egypt	Wind and CSP (concentrated solar power)		Wind and CSP
India	v	V	V
Indonesia	v	V	V
Malaysia	v	V	V
Morocco	v	V	V
Saudi Arabia	v	V	V
South Africa	v	V	V
Thailand	v	v	
Turkey	v	v	V
Vietnam	v	v	

Leaving aside China, the issue is worthwhile for India, where according to Ieefa (Institute for Energy Economics and Financial Analysis) India's industrial policy efforts have focused on solar PV.

The Indian Government has taken several actions to address this situation. Besides tariffs (a basic customs duty, BCD), non-tariff import restrictions (the Approved List of Models and Manufacturers, ALMM) and domestic content requirements, it implemented a production linked incentive (PLI) scheme for solar PV manufacturing in April 2021.

Note that as in EU cell, ingot/wafer and polysilicon production capacity, however, remains marginal or non-existent, with module and cell production being the focus of PLI funding. That means that Chinese supremacy in the production of low value added components are expected not to be defeated[13].

Thus, it seems that up to now, it seems that up to now the effects on emerging countries of US and EU industrial policies are rather small for China, which counts also on a very important expected domestic energy demand[14]; more interesting (after 2026-2027) for India, maybe interesting for ASEAN countries, benefitting from Chinese FDI (foreing direct investments) , and for countries of North Africa (mainly Egypt and Maroc), benefitting from EU FDI.

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[13] It is possible that China shifts the PV low value added components in ASEAN countries components, as it made during the commercial war during the Trunmp Administration.
[14] Scale economies are very important in the PV industry: so a large domestic demand decreases unit costs.