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Dragan Đuričin
World Academy of Art and Science

Aleksandar Kovačević
Oxford Energy

INDUSTRIAL POLICY FOR UNLOCKING THE POTENTIAL OF THE GREEN ENERGY TRANSITION IN SERBIA

Industrijska politika za oslobađanje potencijala zelene energetske tranzicije u Srbiji

Abstract

Market fundamentalism (or neoliberalism) has proven to be a crisis-prone economic model. Within this model, a number of in-built structural imbalances and their interactions have contributed to a downward spiral in economic performance. The end point of this evolution is a multi-crisis in which geopolitics has become an integral macroeconomic variable. Because geopolitics does not function as an antidote but rather as a remedy with predominantly counterproductive effects, the global economy has persistently lost recovery momentum and slipped into deeper crises, while human society simultaneously undergoes geopolitical regression. In such a context, preserving strategic autonomy becomes a particularly demanding task for any national economy. For Serbia, as a small, open, middle-income, landlocked economy on a convergence path toward the EU, this challenge is especially pronounced. These days, strategic autonomy entails a clear vision for accelerating the green transition through a new industrialization based on climate-neutral technologies, primarily in the energy sector and land-use industries. In this paper, we explore key insights into the efforts required to energize the green transition as a roadmap for reversing, or at the very least decelerating, the adverse dynamics of the current economic conjuncture. Serbia serves as the focal point of this analysis, with particular emphasis on the green energy transition as a critical pillar of this complex endeavor. The authors hope that the proposed platform for the green energy transition will be recognized as both feasible and implementable. The zero step in Serbia's green energy transition is the build-up of a nature-centric mindset capable of fostering a so-called "ecological civilization" in the near future. To achieve this, two coordination mechanisms must be combined: the invisible hand of the market and the visible hand of the state. The paper also addresses two additional issues. First, it examines the specific characteristics of investments in biomass-based energy technologies. Second, it analyzes the policy mix required to stimulate investment in related technologies for renewable energy and land-use industries, carbon capture and utilization, grid optimization, lithium production, and other sectors integral to the green transition (e.g., the EV value chain). Building on the preceding line of reasoning, the paper is organized into five main sections, in addition to the Introduction and Conclusion. Part 1 examines the root causes and key deficiencies of market fundamentalism. Part 2 discusses the necessity of the green transition as a pathway toward ecological civilization. Part 3 elaborates a "to-be" scenario for Serbia, based on a circular growth model and a heterodox economic policy platform. Part 4 assesses Serbia's economic preparedness for the green energy transition. Finally, Part 5, the paper's pivotal section, presents a portfolio of green energy projects, providing detailed explanations of biomass-based energy production, which is proposed as the flagship project within Serbia's broader green energy transition agenda.

Keywords: *Serbia, market fundamentalism, structural imbalances, multi-crisis, geopolitics, green transition, circular model of growth, industrial policies, ecological civilization, sustainable economy, renewables, biomass-based energy production*

Sažetak

Tržišni fundamentalizam (ili neoliberalizam) je prepoznat kao ekonomski model koji gravitira ka krizi. U okviru ovog modela, brojne ugrađene strukturne neravnoteže i njihove interakcije dovode do spirale pada ekonomskih performansi. Ishodište takve evolucije je multikriza u kojoj geopolitika postaje jedna od makroekonomskih varijabli. Pošto geopolitika ne deluje kao protivotrov, već pre kao lek sa pretežno kontraproduktivnim uticajem, globalna ekonomija kontinuirano gubi zamah oporavka, pateći od sve dublje krize, dok ljudsko društvo istovremeno prolazi kroz geopolitičku regresiju. U takvom kontekstu, očuvanje strateške autonomije postaje posebno zahtevan zadatak za svaku nacionalnu ekonomiju. Za Srbiju, kao malu, otvorenu, srednje razvijenu ekonomiju bez izlaza na more, koja

se nalazi na putu konvergencije ka Evropskoj uniji, taj izazov je naročito izražen. Danas strateška autonomija podrazumeva postojanje jasne vizije za ubrzanje zelene tranzicije kroz novu industrijalizaciju zasnovanu na klimatski neutralnim tehnologijama, primarno u energetici i sektorima koji se oslanjaju na korišćenje prirodnih resursa. U ovom radu proučićemo ključne smernice za nastojanja da se energizuje zelena tranzicija, kao mapa puta za preokret postojećih trendova ili, u najmanju ruku, za ublažavanje njihovih negativnih efekata. Srbija predstavlja fokalnu tačku naše analize, sa posebnim akcentom na zelenu energetsku tranziciju kao ključnu komponentu ovog složenog poduhvata. Autori se nadaju da će predložena platforma zelene energetske tranzicije biti prepoznata kao izvodljiva i primenljiva. Nulti korak u zelenoj energetskoj tranziciji Srbije predstavlja izgradnja mentaliteta koji uvažava presudan uticaj prirode, kako bi u bliskoj budućnosti došlo do stvaranja tzv. „ekološke civilizacije". Da bi se to ostvarilo, potrebno je kombinovati dva mehanizma koordinacije: nevidljivu ruku tržišta i vidljivu ruku države. U radu će biti razmotrena još dva pitanja. Prvo, specifičnosti programa investiranja u biomasu. Drugo, mere ekonomskih politika usmerene na podsticanje investicija u tehnologije zasnovane na obnovljivim izvorima energije i u grane koje se oslanjaju na korišćenje prirodnih resursa, prikupljanje i korišćenje ugljenika, optimizaciju elektroenergetske mreže, proizvodnju litijuma i druge sektore povezane sa zelenom tranzicijom (na primer, lanac snabdevanja električnih automobila). Polazeći od prethodne linije razmišljanja, ovaj rad je organizovan u pet tematskih celina, pored uvoda i zaključka. U prvom delu razmatraju se izvorišta i ključne manifestacije neefikasnosti tržišnog fundamentalizma. Drugi deo posvećen je razmatranju neophodnosti zelene tranzicije kao preduslova za nastanak ekološke civilizacije. Treći deo analizira „to-be" scenario za Srbiju, zasnovan na cirkularnom modelu rasta i heterodoksnoj platformi za vođenje ekonomskih politika. U četvrtom delu procenjuje se ekonomska pripremljenost Srbije za sprovođenje zelene energetske tranzicije. Konačno, u petom i najvažnijem delu rada, predstavljen je portfolio projekata zelene energije, sa detaljnijim obrazloženjem projekta proizvodnje energije iz biomase, koji je predložen kao vodeći projekat u okviru šire agende zelene energetske tranzicije Srbije.

Ključne reči: *Srbija, tržišni fundamentalizam, strukturne neravnoteže, multikriza, geopolitika, zelena tranzicija, cirkularni model rasta, industrijske politike, ekološka civilizacija, održiva ekonomija, obnovljivi izvori, proizvodnja energije zasnovana na biomasi*

Introduction

The troubling trends of the multi-crisis and their consequences are spilling over into every corner of the global economy. The root cause of this crisis lies in the neoliberal model of capitalism, namely, its key pillars, including the linear model of growth, the nexus of economic rules, and a policy platform based on market fundamentalism. All of these pillars are now being called into question, particularly the prevailing economic rules [39].

According to [17], planet Earth functions as a "system dynamics" composed of socio-economic, physical, and biotic subsystems. The physical subsystem, by definition, operates within natural boundaries. In contrast, under the so-called "open-world hypothesis," neoliberal capitalism promotes a linear model of growth. Based on the assumption of unlimited production and consumption, this model of growth effectively endorses the unrestricted exploitation of natural resources. However, the world is evidently a "closed system," or a system with natural boundaries. As a result of this incompatibility, structural imbalances have emerged not only within the socio-economic subsystem, but also across the physical and biotic subsystems. The key structural imbalances within the physical subsystem include global warming (and climate change), the depletion of natural resources due to overuse, and widespread ecosystem degradation. Structural imbalances within the biotic subsystem manifest through feedback loops such as microbial pandemics, the depletion of biomass reserves, and the accelerating extinction of living organisms. Within the socio-economic subsystem, the key adverse effects of market fundamentalism include the decoupling of financialization from industrial production, income concentration, persistent budget deficits, and escalating public and private indebtedness. These imbalances are of mammoth proportions. For instance, global debt has surpassed USD 100 trillion [47], more than double the total of all global public budgets and nearly equivalent to global GDP (94.7%). Moreover, triple-digit budget deficits now characterize many of the world's most advanced economies. For example, Japan's budget deficit stands at 230% of its GDP [50].

The coordination mechanism of neoliberal capitalism, rooted in the market self-regulation theorem, operated with relative effectiveness for nearly two centuries under liberal capitalism, including the brief period of the welfare state. However, over the past half-century of market fundamentalism, this mechanism has proven increasingly inadequate. The reason lies in the emergence of damaging blind spots concerning nature, largely due to the disregard of natural boundaries and the negative external effects of industrialization. Paradoxically, the very forces that once fueled economic prosperity have

now precipitated a prolonged and deep regression in both components of socio-economic system. Namely, the key drivers of growth and prosperity have been transformed into causes of regression. This change has rendered the prospect of sustainable and inclusive economic growth, toward both people and nature, truly unattainable.

In most developed economies, neoliberalism, along with its extreme ideas such as radical liberalism, has largely lost credibility. Its ideological appeal, once highly influential among developing economies, has also significantly waned. On this matter, there is a convergence between theoretical and practical perspectives. The logic is straightforward: the problems confronting today's global system cannot be resolved using the very concepts that helped produce them. There is also growing awareness that no national economy can thrive on a dying planet. In short, the linear growth model and the economic policy platform based on market fundamentalism are driving the global system toward a point of no return.

Despite their full compatibility with the interests of the business elite, effectively a corporate overclass, neoliberal economic rules, as articulated in the Washington Consensus [51], such as profit maximization, liberalization, deregulation, privatization, and globalization, remain fundamentally misaligned with natural boundaries and the laws of nature (primarily reversibility and evolution). Reversibility reflects the physical law that the total volume of matter and energy within the world, as a closed system, remains constant despite continuous transformation into different forms. Evolution denotes a process of diversification driven by adaptation to a changing environment.

In the context of the ongoing multi-crisis, the Washington Consensus, whether referred to as market fundamentalism, neoliberalism, or the rule-based international economic order, has become counterproductive, as the nexus of rules on which it is based stands in contradiction to the planet's biophysical limits. It is increasingly evident that Earth's ecological capacity cannot sustain the development ambitions of key economic agents. The overuse of finite resources, driven by rapid industrialization, urban expansion, and mass transportation, has triggered cascading material disbalances and pollution. A key manifestation of this degradation is global warming. However, the overuse of limited resources and the associated pollution represent only part of the broader narrative of planetary unsustainability. Numerous other systemic disruptions, linked to the same industrial, urban, and transport-driven dynamics, further exacerbate the crisis.

No doubt, the survival of humanity depends on restoring harmony with nature. Global warming and climate change, along with the resulting imbalances within the planet's socio-economic, physical, and biological subsystems, are now universally recognized. They are root causes of overall unsustainability. The combined effects of the overuse of limited resources and environmental pollution have generated cascading imbalances across the layers of Earth's systemic dynamics, giving rise to the multi-crisis.

During the multi-crisis, the ultimate goals associated with neoliberalism, such as democracy (both political and economic), prosperity, and sustainability, have become vast goals, even challenges. Policymakers across national economies have failed to achieve even a single one of these goals, let alone navigate the complex trade-offs between them. The architects of a new economic system must rethink the prevailing logic based on conventional economics rules, most notably, the notion of the "free good" and the systematic disregard for negative externalities. Also, new economic rules should respect planetary boundaries (the scarcity of material resources, the laws and evolutionary dynamics of nature). Last but not least, as escalating geopolitical tensions continue to erode the potential for global cooperation on climate change solutions, there is a growing need to advance peace-oriented science. Such a scientific orientation could offer responses to two key challenges of the modern world, the "weather of mass destruction" (WMD) and the military-oriented science focused on developing "weapons of mass destruction" (WMD). Confronting this dual threat, what may be termed the 2WMD (Weather of Mass Destruction + Weapons of Mass Destruction), requires replacing conflict-driven innovation with science dedicated to sustainability of economy, society and planet.

When the pieces of the socio-economic puzzle do not fit together, and when its functioning is not in harmony with natural boundaries, the free fall becomes inevitable.

Consequently, a great majority of relevant economists view 2026 as the most dangerous year since the rise of neoliberal capitalism in the early 1980s. The most alarming field is, arguably, climate change. The situation at UN COP30 [53] appears even worse than it was at COP29 [46], reinforcing the urgency for COP31 to fast-track its efforts to advance solutions to the climate emergency.

Amid the escalation of geopolitical tensions, there is growing uncertainty about the direction of global affairs. At this stage, the Paris Agreement's 17 SDG targets [48], including the target to reduce emissions from the world's ten largest greenhouse gas emitters by 45% by 2030, and to achieve net-zero emissions by 2050, remain largely hypothetical. Despite the absence of genuine optimism regarding the attainment of the established SDGs by the projected deadline, the critical inquiry persists as to the extent to which they will ultimately be achieved, whether 60%, 80%, or less [25], [26].

Some critical voices emphasizing weaknesses of neoliberal capitalism must be taken seriously. We must learn more quickly from identified fault lines, overestimations, and historical misjudgments [5]. Moreover, demographic trends among global powers, from the U.S. and the EU to China, speak for themselves. Populations are shrinking and aging, resulting in pronounced labor force deficits. This is not only a significant economic issue, but also a form of social pathology, entangled with many ethical, political, and geopolitical challenges. In contrast, much of the developing world faces the opposite problem, high youth unemployment and related social dislocations, primarily the migration of young and/or well-educated individuals. So, this creates a paradoxical situation in the labor market: in the most developed economies, there are not enough people on the "right" side, while in many developing countries there are too many people on the "wrong" side, excluded from productive engagement.

Because the challenges described above are deeply interrelated, escaping the multi-crisis requires a multi-transition, supported by a new policy agenda that aligns ultimate goals, such as democracy (both political and economic), a robust middle class, and a sustainable economy, with a pivotal role for structural or industrial policies in the tradable sector. Democracy depends on the existence of a stable, empowered middle class and the systematic eradication of poverty, achievable only through moderate to strong economic growth. Also, the greening of the economy, particularly in energy and land-use sectors, can help halt, or at least slow, the progression of climate change. The green transition offers not only ecological benefits, but also opportunities for a new industrialization based on climate-neutral technology. This path is neither infeasible nor too late to pursue, and it can be implemented within each national economy, regardless of local specificities.

Multi-transition is most commonly referred as the "green transition," a construct associated with the notion of an "ecological planet," or the planet as it functioned prior to large-scale industrialization. The green transition seeks to realign human-created components of system dynamics (socio-economic subsystem), with the broader living subsystems of nature (physical and biological subsystems). The alchemy of the green transition lies in its capacity to transform a paradigm of unlimited extraction of limited resources into systems of extraction, regeneration, and the reinvention of inputs essential for climate-resilient industrialization. A key advantage of the green transition is its capacity to address ecological, economic, and social objectives simultaneously within a single, integrated framework.

Energy security is a critical component of the green transition and should be explicitly included among the expectations guiding the sustainable development agenda in every national economy. In the case of Serbia, the installed lignite-fired power generation of approximately 4,300 MW significantly exceeds its operational capacity of around 2,800 MW. This current energy output gap based on fossil fuels, amounting to roughly 30% of installed capacity, poses a substantial obstacle to progress in both the energy transition and the EU accession process. For a country in the process of EU integration, convergence in the level of economic development and in energy goals serves as a critical performance indicator. Measured in terms of GDP PPP p.c., Serbia faces a significant development gap of roughly 40% vis-à-vis the EU average. Bridging this gap would require Serbia to sustain a CAGR = 7% over a

10-year period, assuming the EU grows at a steady CAGR = 2.5% over the same period [9, p. 17].

Another problem lies in the structure of Serbia's energy output, which remains heavily dominated by lignite, accounting for over 60% of electricity and heat production. To align with the global net-zero emissions target by mid-century, Serbia must fully phase out fossil fuel-based energy generation and replace it with a diversified energy mix based on carbon-neutral, domestically sourced renewable technologies, including biomass, geothermal, solar, wind, and hydropower. Without huge investment in the green energy transition, both the energy output gap and the carbon-intensive structure of Serbia's energy system will remain a major barrier to sustained economic growth and convergence with the EU.

Given the legacy of the aforementioned structural imbalances, only a broad policy approach that combines market mechanisms with a normative approach, anchored in industrial policies, can effectively address the challenges ahead. When properly structured, the green energy transition delivers a triple dividend. First, the elimination of the energy output gap. Second, the creation of new development opportunities through the ripple effects generated by the deployment of climate-neutral energy technologies. Third, a climate-resilient future by advancing nature-based solutions. In short, the green energy transition is an imperative, not a choice.

Global Multi-Crisis: From Bubble to Bubble

Understanding root causes, those that the new economy must ultimately address, is essential for the transition from the "as-is" scenario toward a "to-be" scenario inspired by sustainable development. Predictability is always contingent on the identification of what are commonly referred to as "known unknowns." By contrast, where "unknown unknowns" dominate, predictability becomes virtually impossible, particularly in the context of a "to-be" scenario.

The central position advanced in this paper is that the multi-crisis is fundamentally altering the functioning of the global economy in general and national economies in particular. The current conjuncture may also be characterized as a "polycrisis," a "rolling crisis," a "crisis within a system of crises," or even a "crisis of crisis." Among these, the construct of the "multi-crisis" arguably offers the most accurate depiction, capturing not only the simultaneous emergence, interaction, and mutual amplification of multiple crises (climate, financial, economic, social, biotic, geopolitical, etc.), but also the deeper reality in which the root causes of these structural imbalances, along with the inadequacy of policy responses, have been internalized and normalized within dominant economic narratives as the so-called "new normal."

To clarify the causal and chronological sequencing of the multi-crisis's root causes, let us begin with global warming (and climate change). In May 2024, for the first time, the Earth's average temperature exceeded 1.5°C above pre-industrial levels, specifically, those of the late 1800s, when the market economy began leveraging technological breakthroughs from the successive waves of industrial revolutions (1IR-4IR). Solar radiation reaching the Earth's surface is partially absorbed and subsequently re-emitted as infrared radiation (heat), which is increasingly retained in the atmosphere by elevated concentrations of greenhouse gases. This enhanced greenhouse effect is estimated to account for approximately two-thirds of the observed global warming. The remainder is attributed to natural climatic variability, most notably the Milankovitch cycles, which describe long-term changes in Earth's orbital dynamics and axial tilt [30].

The Paris Agreement [46] established the goal of limiting global temperature rise to 1.5°C above pre-industrial levels by 2050. Unfortunately, amid delays in the proposed green transition and escalating geopolitical tensions associated with ongoing armed conflicts, the global climate agenda has lost momentum, and the narrative surrounding corrective climate action has been significantly diluted. According to COP 30 [53], by early 2026 the planet is expected to experience its first twelve-month period with average temperatures exceeding 2.3°C above pre-industrial levels. Anyhow, the needle of systemic change has barely moved, revealing a profound disconnect between scientific urgency and policy responses.

Although climate change is a borderless phenomenon, Europe is warming at a significantly faster rate than

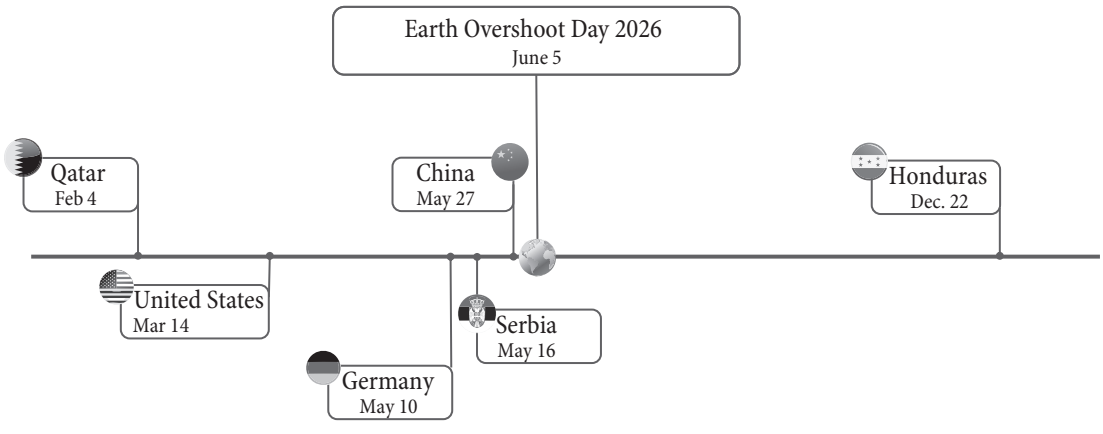
other continents. The EU is *de facto* in the state of climate emergency. As Ph. Aghion observes [1], the EU functions as a "regulatory giant and a budgetary dwarf." This asymmetry has notable spillover effects, both physical and administrative, particularly for non-member states in the EU accession process on the Union's periphery, such as Serbia. A good example is the Carbon Border Adjustment Mechanism (CBAM), which imposes regulatory obligations on accession countries without providing clearly defined financial support mechanisms from the EU to facilitate compliance.

Ecosystem degradation represents another major structural imbalance within the neoliberal system, primarily driven by the overuse of non-renewable natural resources. This anomaly reinforces the increasingly evident reality that "the planet is not enough" to support the developmental ambitions of economic actors. Figure 1 illustrates the resulting global supply-side shortage. Namely, the concept of "World Overshoot Day" [19] marks a break-even point in the calendar year when humanity's resource consumption exceeds Earth's capacity to regenerate those resources within the same year. From that point onward, the socio-economic system operates on ecological credit at the expense of future generations. As depicted in Figure 1, the global economy is projected to reach this ecological threshold as early as June 5 in 2026.

Moreover, under the linear model of growth, biosphere reserves have undergone a dramatic decline, contributing to an alarming extinction of living organisms. Over the past half-century, the planet's biotic system has lost approximately 50% of its living organisms. This pattern reflects an unfolding mass extinction, occurring in stark contrast to the natural principles of regeneration and evolutionary resilience that underpin ecological systems. In sum, the planet is not enough to support the "as-is" linear model of growth (see Figure 2). Figure 2 also shows that if, in 2026, the rest of the world were to consume natural resources at the same *per capita* rate projected for the U.S., global biophysical capacity would need to increase by more than fivefold, equivalent to 5.1 Earths.

Income inequality constitutes an evident structural imbalance, highlighting the economic and social unsustainability of the current system. According to Oxfam [38], the richest 1% ("top one percent") hold more wealth than the bottom 95% of the world's population put together. Moreover, fewer than 60,000 individuals, representing approximately 0.001 percent of the world's population, control three times as much wealth as the entire bottom half of humanity [3, p. 12]. Due to income (and wealth) inequality, in advanced economies, this disparity has translated into a situation in which roughly half of the working-age population has been excluded from the benefits of macroeconomic growth over the course of their working lives. Simultaneously, the disproportionate income gains of top earners have coincided with stagnant or declining incomes among lower and middle-income groups, eroding social cohesion. For instance, for younger generations, student loan repayments and housing rents

Figure 1: World Overshoot Day 2026



Source: Global Footprint Network [19]

often consume more than half of their monthly income. Ultimately, income (and wealth) inequality acts as a constraint on economic growth by reducing aggregate demand among lower- and middle-income earners, while incentivizing rent-seeking behavior among top earners.

A widely recognized metric for measuring income inequality is the Palma Index, defined as the ratio of the income share held by the richest 10% of the population to that held by the poorest 40% [42]. The concept focuses on the extremes of income distribution, grounded in the empirical observation that the middle 50% of the population tends to maintain a relatively stable share of national income, while the top and bottom segments exhibit more pronounced fluctuations. In most developed economies, the Palma Index exceeds 1.0, indicating a high degree of income concentration within the top decile. Figure 3 presents one version of the Palma Index for selected countries.

Parallel to the trends discussed above, the champions of neoliberalism have experienced a deterioration in state-owned equity. In the U.S., for example, estimates of net public wealth (public assets minus public liabilities) relative to national income suggest a decline from roughly 50-100% in the 1970s-1980s to around zero, and in some WID-based accounts even negative territory [36]. This erosion is linked to a combination of asset privatization and the cumulative build-up of public liabilities, particularly public debt. In such a setting, negative state equity is not just an accounting curiosity: it reflects persistent deficit bias and debt expansion, often reinforced by soft budget constraints [2].

The need to finance negative public equity has empowered holders of sovereign debt instruments (e.g., government bonds) to exercise political leverage over economic policy and key political processes, thereby preserving the *status quo* in both the economy and society.

A defining challenge of our time, unlike any in previous history, is that the structural imbalances embedded in the current economic system cannot be resolved through technological change as a panacea, despite the rapid influx of innovations brought by the fourth industrial revolution (4IR) and artificial intelligence (AI) breakthroughs. The dominant coordination mechanism for resource allocation, grounded in market fundamentalism, is incapable of reconciling the risk-taking behavior of private investors with broader social benefits. Namely, income and wealth concentration in the hands of a corporate overclass inhibits high-risk investment. Consequently, overall profitability and

Figure 2: Planet Is Not Enough

Source: National Footprint and Biocapacity Accounts 2025 edition [18]

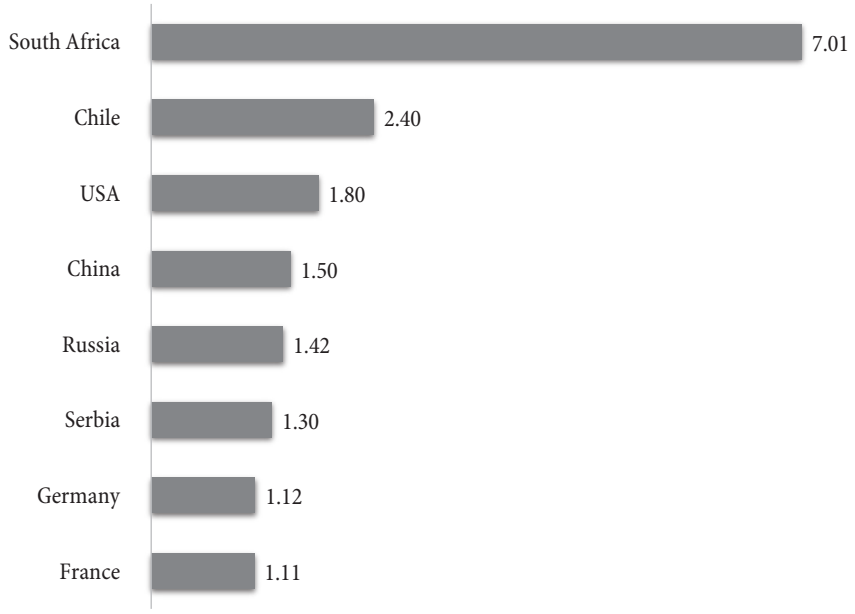
economic dynamism decline, a trend further exacerbated by intensifying demands for redistribution within an ecosystem of stagnating income growth.

Within the corporate overclass, concern extends beyond the risk-return calculations of emerging technologies to their broader purpose. The fear of robotics and artificial intelligence now outweighs anxiety about competitors, the working class, and/or state technocrats. This fear, rooted in unintended consequences associated with new technologies, has contributed to a decline in risk appetite for their development and implementation. As a result, the tech sector giants have played a central role in inflating the current financial bubble of epic magnitude, with regulators and state institutions sharing responsibility through inaction and/or delayed action. Circular investments and/or vendor financing, and/or successive securitization within the tech sector's value chain (AI, data centers, chip manufacturers, ICT infrastructure providers, etc.), have significantly contributed to inflated bubbles. For instance, NVIDIA's market capitalization now approaches the scale of the Federal Republic of Germany's GDP [27]. A well-known pattern is once again unfolding. Namely, a sudden reversal in demand for these inflated assets could trigger severe repercussions for the global economy, particularly if such a shock is not offset by sufficiently robust domestic market development. The eventual bursting of these asset bubbles would generate disruptive effects across a broad spectrum of stakeholders, including shareholders, financial intermediaries, financial markets, employees, taxpayers, and the economy at large.

Beyond in-built structural imbalances, misconceptions of policy responses to imbalances and unlimited financialization, the modern economy is also exposed to external asymmetric shocks such as climate change, microbial mutations, geopolitical disputes, etc. Unlike internal or self-inflicted shocks, external shocks are characterized by their asymmetric impacts. Although they affect all, the intensity and consequences vary significantly. Often, the hardest hits are those least responsible for their genesis. Also, their consequences are difficult to anticipate because they are subtle, multiple, and delayed.

In addition to evident local imbalances, global imbalances also play a critical role. Available data indicate that the U.S. and the EU, as economic superpowers, are both experiencing relative decline. The export trajectories of two economic giants, the U.S. and China, which together account for approximately 40% of global GDP, have diverged markedly. In 2025, the U.S. current account deficit approached 5% of GDP. China, whose share of global GDP in absolute terms has nearly tripled over the past two decades, recorded a trade surplus of USD 1.2 trillion in 2025, equivalent to a current account surplus of approximately 3% of GDP [22].

Figure 3: Palma Index by Country



Source: SDG Index Dashboards, based on the Sustainable Development Report 2025 [45]

Trade and output imbalances among global superpowers are compounded by a fragmented, mainly inefficient, and unpredictable global financial system. These days, the stability of such a system depends heavily on financial mega flows, particularly those tied to investments in the AI cluster and cryptocurrencies. According to Eichengreen [10], investments in the AI cluster alone accounted for as much as 80% of the increase in U.S. final private domestic demand in 1H 2025. In this system, credit production is regulated through banking sector supervision shaped by the influence of two to three central banks (Fed, ECB, and BoE), as well as by the catalytic role of the banking lobby. When the real economy proves impotent and regulators lack effective corrective mechanisms to contain inflated bubbles in financial markets, the prices of gold and silver tend to skyrocket, reaching all-time highs. In 2025, the price of gold increased by 90%.

Moreover, all over the world, people are increasingly affected by pronounced behavioral imbalances. Social networks significantly impact the cognitive, emotional, and psychological well-being of their users, particularly among youngsters. They are frequently associated with so-called "brain rot" [29], a condition linked to the simplification of decision-making processes and the narrowing of individuals' expectations horizons. Social networks operate as "echo chambers," disseminating extreme opinions and oversimplified explanations throughout network. In doing so, they serve as an effective tool for shaping the population's mindset. The result is the emergence of the so-called "network capitalism," in which new generations prioritize affiliation with digital communities and adherence to influencer culture over traditional values such as creation, ownership, or long-term contribution.

In the last stage of the multi-crisis, geopolitics and its instruments have become the most impactful external asymmetric shock, significantly influencing the macroeconomic equation. When the economy falters and growth persistently loses momentum, geopolitics enters the arena. Clearly, the rising weight of geopolitics does not merely reflect an exacerbation of the dominance habit; rather, it requires close attention to its new and evolving manifestations. In periods of heightened geopolitical tension, certain goods and services are not only subject to steep tariffs, as in the case of oil and gas, but also become objects of weaponization, particularly in the case of critical natural resources such as uranium, rare metals, and even food. In this way, strategic products/technologies, including semiconductors and leading-edge innovations (AI, Bio-Four, etc.), are being excluded from global markets. Under these new circumstances, the freedom of maritime trade and navigation is also increasingly under threat.

The intensification of proactive measures and reactive countermeasures inspired by geopolitics has created a pretext for the militarization of the economy. The worst has replaced the bad. A vast majority of developed economies in the Western hemisphere are facing a collective economic trauma, as the political class, motivated by a persistent dominance habit, continues to drive both the economy and society toward rapid and large-scale militarization. For example, EU defense expenditures have risen for ten consecutive years. In 2025, global military spending reached USD 2.7 trillion. The militarization of the economy becomes a pretext for war. Yet in modern warfare, there can be no true winners. Moreover, there is no significant technological advantage among military superpowers, nor is there strong public willingness, particularly among younger generations, to participate in a potential WWIII.

There is no doubt that, in an emerging strength-based order, geopolitically driven militarization acts as a tectonic force reshaping the global trade and investment. A political class beholden to the corporate overclass and guided by deeply rooted ideological predilections, while increasingly detached from economic realities, has placed the global socio-economic system at risk through its persistent failure to make decisions grounded not only in sound economic reasoning but also in basic common sense.

Economic sanctions (and counter-sanctions), tariffs and counter tariffs, restrictions on maritime commerce and navigation, wars (proxy and real) are undermining the foundations of free trade and investment. These disruptions disproportionately affect low and middle-income countries, particularly those that are small, open, and landlocked. The resulting turbulence affects not only economic and social stability but, more critically, erodes STEM capacity (science, technology, engineering, and mathematics), a

performance dimension essential for future development, thereby slowing the structural transformation of developing economies toward advanced status. In particular, the weaponization of big science, research and development, and engineering has turned scientists and engineers into collateral casualties, especially in contexts least equipped to absorb such losses.

Geopolitically driven measures in a world of universal connectivity have triggered both deglobalization and re-globalization as a new phase of globalization shaped by geopolitical criteria. When key geopolitical players engage in a multidimensional chess game across military, economic, and diplomatic spheres, non-aligned states, particularly small, open, and medium to least developed economies, risk losing strategic autonomy. By being "stuck in the middle" of rival power blocs, they face pressure from both sides while remaining unable to fully leverage the opportunities presented by either.

In the realm of geopolitics, there are no true winners in the economy. Geopolitics and geoeconomics are Siamese twins, inseparably linked and mutually reinforcing. Economic sanctions, the most commonly employed instrument for addressing geopolitical disputes, lead to a "lose-lose" outcome that tends to deepen existing structural imbalances. In economies subject to economic sanctions, GDP typically contracts as a result of reduced international trade and declining foreign investment. Meanwhile, countries imposing sanctions often face commodity scarcity and heightened price volatility, particularly in energy markets, leading to output gap and mounting stagflationary pressures. Rare earth minerals and metals have emerged as a critical flashpoint. To de-escalate tensions in the tariff war, some countries, such as China, have responded with embargoes on rare earth minerals and metals. For example, following U.S. tariffs targeting Chinese online retailers and high-tech exporters, China responded with export restrictions on rare earth elements, directly impacting U.S. high-tech industries dependent on these inputs. Once again, such dynamic reflects a lose-lose scenario.

As geopolitical tensions escalate, some economic indicators of distress amplify the effects of other toxic stressors, rendering the prospect of a global free fall increasingly plausible. In such a destabilized regime, the world economy hangs by a thread.

All these developments have significantly eroded public trust in the prevailing order, which appears to serve the interests of the corporate overclass and the political elites lobbying for them. In this evolving context, public willingness to support meaningful change is weakening, giving rise to a range of social pathologies, including growing polarization between the far left and the far right.

For all the reasons discussed, both professional and academic circles increasingly recognize the linear model of growth, and the market fundamentalism, often treated as an ideology if not a quasi-religion, could not be treated as the solution, but as a fundamental cause of the current multi-crisis.

Since the Great Recession of 2008, humanity has been gripped by two converging fears, with the multi-crisis solidifying as the new normal. The first is a "fear of fear" itself, reinforced by persistent disruptions in the global economy and financial markets, further exacerbated by trade wars and resurgent protectionism. The second is the "fear of peace," stemming from a perverse trajectory of deglobalization and a redefined globalization driven by geopolitical criteria, resulting in the widespread militarization of both the economy and society. The mantra "with us, or against us" in geopolitical positioning leaves little room for compromise and is unlikely to foster peaceful resolution of disputes. Moreover, under the impact of this new mantra, local points of conflict (Ukraine, Israel, Iran, Somalia, Congo, Cambodia, Nigeria, Venezuela, etc.) could rapidly escalate into a full-fledged global war. Even so, since every war is ultimately unwinnable, a potential WWIII, driven by the combined effects of 2WMD, could represent the final crisis for the global economy, humanity, and possibly the planet as a whole.

Green Transition as a Path toward Ecological Civilization

In the Anthropocene era, which began after the First Industrial Revolution, the wars waged by human beings, both against nature and among themselves, have intensified, particularly under neoliberal capitalism as the last stage

of capitalism. The root cause of these escalating conflicts lies in the dominance mindset, driven by an ideology of exceptionalism. The key consequence of this mindset is the pursuit of self-interest over collective well-being. Such behavior is self-defeating, as the planet operates as a closed system rather than an open one, where all forms of expansion are subject to natural limits. In such a closed system, zero-sum games may occur, but they are fundamentally unsustainable.

During the Anthropocene era, humanity is sitting in the driver's seat, propelled by the synergistic effects of social innovation and emerging technological trajectories that have boosted productivity, increased output, and enabled structural changes. Unfortunately, over time, fault lines and overestimations in the design and functioning of the socio-economic system, particularly during the period of market fundamentalism in the most advanced economies and their followers, have resulted in persistent and increasingly intractable structural imbalances across system dynamics. An untuned economy and fragmented society, both marked by a loss of cohesion and characterized by persistent output gaps and their unsustainable structure, mainly through financialization, cannot restore balance on their own. Market mechanisms are inherently ill-equipped to correct the system's dysfunctions. These trends are further aggravated by policy failures, external asymmetric shocks, black swans, and widening behavioral divergences within modern societies, all of which exacerbate the fractures embedded in the system's design.

Following the Great Recession of 2008, efforts to manage human-induced physical structural imbalances, such as global warming, natural resource depletion, and ecosystem degradation, alongside socio-economic distortions including financialization (deindustrialization) and income inequality, have faltered under successive iterations of neoliberal economics rules.

In the search for solutions, a paradigm shift grounded in the imperative to reconnect the economy with its natural limits is emerging. Put simply, at this critical juncture in history, survival, not just prosperity, depends on the establishment of a socio-economic system capable of realigning people, purpose, and the planet's capacities. The first and most fundamental transformation must concern the very character of the socio-economic system itself.

The modern socio-economic system is best understood as a non-linear, rather than linear, construct. In such system, heuristics tend to prevail over optimization models. Non-linear systems are characterized by pervasive unknowns, whether framed as risks or simply as deep uncertainty. Among these, planetary or exogenous unknowns increasingly overshadow macroeconomic, financial, fiscal, corporate, and individual ones. Planetary unknowns comprise interdependent, non-linear components engaged in endless interactions. These components have asymmetric impact, meaning they elicit distinct and context-specific responses across different economic agents and systems.

In national economies with structural imbalances and without in-built corrective mechanisms, the accumulation of macro deficits (current account, fiscal, and capital) is imminent. This cumulative pressure progressively constrains fiscal space, undermining the capacity to rectify systemic flaws and to adjust to technological change. Furthermore, the frequency and magnitude of disruptions triggered by the complex, holistic interactions of non-linear system components, particularly around tipping points such as multiple feedback loops and misaligned responses to black swans, are growing exponentially. These developments have produced a global headwind of structural imbalances that have become institutionalized as the "new normal." This dysfunction has reduced the capacity of national economies to recover and prosper through reliance on the "invisible hand" of the market. In the absence of robust, state-led coordination mechanisms to correct structural imbalances, economies burdened by such profound inefficiencies cannot achieve sustainability. And what is not sustainable, ultimately, cannot endure.

The first step in crisis mitigation is to move beyond merely "dancing with paradigms" and focus on establishing a set of rules that enables recovery, or long-term sustainability. In the context of the multi-crisis, alternative models such as stakeholder capitalism [43] and the social market economy [28] have gained prominence. Both concepts are viable, insofar as they contribute to sustainability. In this regard, the final destination of the green transition is a sustainable economy.

Humankind can and will survive, despite the entrenched human tendency toward domination over other humans as well as nature. As the old saying goes, "to be ahead of the curve, you must be in line with reality." In today's context, this means that reality is defined by planetary boundaries. Fully unpacked, this means the world economy does not possess sufficient resources to meet the development ambitions of all players in the game (startups, incumbent companies, national economies, multinational companies, supranational institutions, or any). This becomes especially evident in periods of major geopolitical confrontation, when some critical resources, such as oil and gas, uranium, rare earth metals, and even food, are weaponized and removed from open market dynamics. Using geopolitics as leverage creates a strength-based order with recurrent seismic disruptions within the global economic system. Moreover, the proliferation of sanctions, counter-sanctions, extreme tariffs and counter tariffs, increasingly reduces economic policymaking to a form of geopolitical theater, often bordering on parody. In extreme cases, these measures yield paradoxical outcomes. For example, energy bans and elevated tariffs imposed by the U.S. and the EU on Russia and China have, in certain respects, bolstered rather than weakened the targeted economies.

With respect to carbon dioxide (CO_2) and the six equivalent greenhouse gases, technological progress can convert climate-related challenges into economic and developmental opportunities. While the impact of rising atmospheric concentrations of greenhouse gas emissions is commonly analyzed through the lens of radiative forcing and its contribution to global warming [7, p. 4], it is important to recognize that CO_2 is also a chemically reactive molecule with far-reaching biochemical effects. For example, CO_2 significantly influences the two core biological processes underpinning Earth's biosphere: photosynthesis and respiration. Elevated atmospheric CO_2 levels are known to enhance the rate of photosynthesis, thereby boosting agricultural yields. However, this effect does not typically translate into increased nutritional value of the resulting crops. In contrast, heightened CO_2 concentrations can adversely affect respiration, impairing the metabolic rates of metazoans and diminishing human cognitive performance, even at concentrations only slightly above present levels. Another negative consequence is ocean acidification, driven by the absorption of excess CO_2 into seawater.

Complex problems require complex responses. Structural imbalances inherent to the current economic architecture, along with existential ecological threats, cannot be addressed through self-regulating market mechanisms. Building a truly sustainable economic system requires a comprehensive overhaul of prevailing paradigms, one that confronts the root causes of the ongoing multi-crisis rather than merely mitigating its most visible symptoms through ad hoc policy measures. To do that, humanity needs a new social taxonomy, particularly within energy and land-use-intensive sectors such as power generation, agriculture, manufacturing, construction, mobility, forestry, and waste management. This taxonomy should guide system architects not only in adopting radical change but also in ensuring continuous improvement in aligning the economy, society, and the planet within natural limits. In practice, this implies the creation of normative mechanisms to correct structural imbalances, mobilize financing for green investments, and measure both their financial and non-financial effects.

In this endeavor, there is no overnight solution or singular window of opportunity to simultaneously mitigate the current crisis and build up a new economy. The development of a sustainable economic system requires coordinated efforts aligned under a unified vision of multi-transition (climate, economic, biotic, geopolitical, etc.), from the existing system dynamics to a more resilient and sustainable framework. The outcomes of this journey must themselves be sustainable. If pursued with strategic focus and consistency of action, this approach could bring the planet to a climate-neutral inflection point, a critical milestone marking the beginning of a new phase of long-term sustainability.

The green transition, as a shift from the current to a new trajectory, is inherently a technology-driven process. If the internet serves as the infrastructure of the digital era, AI now functions as a general-purpose technology, on par with 4IR tools and concepts. In the emerging digital platform economy [6], universal connectivity is a free good,

enabling seamless digitalization across the entire value chain in both the real economy and service sectors. An almost endless influx of innovative amalgams is emerging at the intersections of various technologies, propelling a convergence revolution across virtual (or cyber), and/or physical, and/or biological technologies. In this new level playing field, combinatorial innovations can and will play the role of the principal engine of transformation. Virtualization, another key legacy of frontier technologies, is accelerating and deepening digital transformation through tools such as digital twins, data centers, and related useful breakthroughs.

AI is the flagship technology of the new era and a key infrastructure enabling the structural alignment of the economy and society. Yet, in some contexts, it functions like a "neutron bomb," replacing people and keeping machines. While discussions on regulatory guardrails for AI development begins to take shape, pre-existing structural imbalances are deepening. Without intentional corrective action, AI risks perpetuating and amplifying these disparities, particularly at a moment when collective human ingenuity and coordinated global efforts are urgently needed. Ensuring AI accountability and fostering broad-based awareness of its implications must go hand in hand with confronting the dual crises of accelerating climate change and extreme concentration of wealth, both symptoms of the prevailing, toxic paradigm of market fundamentalism.

From the perspective of incumbents, especially the workforce, combinatorial innovation is profoundly disruptive. The accelerated shortening of product life cycles presents significant challenges, even for established industry leaders. In response, the state's role in orchestrating and financing innovation is gaining prominence within evolving institutional settings. Increasingly, governments are shifting from fostering competition to facilitating strategic cooperation among the players of the competitive game, primarily through targeted industrial policies designed to guide innovation and structural transformation towards climate neutral industrialization.

To address the major negative consequences of the neoliberal economic system, humanity must unite in both intent and action to tackle the root causes of global imbalances. This entails a strategic shift toward a progressive socio-economic system, one that not only harnesses frontier technologies but also ensures their alignment with ecological limits and ethical standards that safeguard collective well-being. The intention is not to postpone development of frontier innovations, but to send a clear message to developers: continuing on an un-ethical, business-as-usual trajectory threatens to exacerbate systemic crises and undermines the prospects for an inclusive and sustainable future.

Ethical renewal requires a relational worldview and a fundamental reimagining of humanity's position within the planet, based on the pursuit of harmony among the subsystems of system dynamics. Reconciling the human-made socio-economic subsystem with the Earth's natural subsystems calls for a concerted effort. In this endeavor, the concept of convergence through plural pathways reinforces a holistic approach, one that synthesizes science, governance, finance, and ethics to support sustainable development across varied institutional and cultural landscapes.

In support of these propositions, science (basic, social, and humanistic) stands as the principal engine. In an era marked by resource scarcity, major scientific breakthroughs must be internationally prioritized and governed with the explicit aim of advancing an "ecological civilization." While new technologies offer transformative opportunities for development, they must be assessed not only by their economic potential but also by their capacity to foster sustainability and adhere to the ethical standards underpinning a just and resilient society.

Investment in research and development to generate frontier innovations is necessary but not sufficient on its own. Without the parallel implementation of pro-innovation industrial policies in key domains (primarily energy and land-use industries), as well as the development of a financial system that incentivizes risk-taking by real-economy firms and institutional investors, competitiveness will remain constrained. For developing economies in particular, this means remaining locked into a cycle of mid-tech, incremental innovations, and low-value-added exports, rather than advancing toward technological self-sufficiency and structural transformation.

Alongside the bad news, the good news is that the leading trends shaping the current "new normal" are anthropogenic, or created by humans. This implies that, with an appropriate paradigm shift and corrective policy measures, these dynamics and their interrelated consequences can also be mitigated by human action. This logic forms the foundation of our approach to navigating the ongoing multi-crisis in the case of Serbia. It is particularly evident in our focus on redefining the model of growth and establishing a related policy platform.

In the neoliberal version of capitalism, the conflict between market fundamentalism and hyper-globalization represents a distinct paradox. As national economies become ever more integrated, their economic agents, policymakers, and even society itself have become increasingly fragmented from within. This internal disintegration of socio-economic system, in turn, renders Planet Earth and its interconnected subsystems untenable. Earlier policy responses grounded in Keynesianism, social democracy, and the welfare state temporarily stabilized capitalism and, in effect, saved it from itself. However, these approaches ultimately failed to mitigate the previously mentioned conflict. For decades, economic theory has framed unsustainability primarily as a technical problem to be solved, rather than as a structural consequence of economic rules in need of fundamental transformation. So far, such an approach has driven humanity deep into ecosystem disruption, progressively undermining the physical and biological base of socio-economic development. After such long-standing misconceptions, the critical question that emerges is how to transform a declining civilization into an ecological civilization, that is, ultimately, a sustainable civilization.

Serbia at a Crossroads: From the As-Is to the To-Be Scenario

The year 2025 will be remembered as another phase in a prolonged multi-crisis, marked by the deepening and widening of structural imbalances at both the global and local levels. The long-standing multi-crisis has forced the architects of the socio-economic system to explore alternative ways in which the economy and society can be transformed, function and prosper within planetary boundaries. By selecting the green transition as the vehicle and ecological civilization as the destination of this journey, humanity is redirecting its focus toward aspirational outcomes such as a sustainable economy, equitable well-being, and a healthy planet. At the global level, achieving these outcomes requires, at a minimum, a coherent nexus of solutions based on a shared worldview aligned with planetary boundaries. Local governments will play a catalytic role in translating this worldview wisdom into practice in pursuit of strategic autonomy.

Planet Earth cannot sustain the current socio-economic model based on the unlimited growth of production/consumption, excessive demand for natural resources beyond responsible reserves, and persistently high and growing levels of carbon footprint. Humanity therefore needs sustainable solutions firmly aligned with planetary boundaries before irreversible thresholds are crossed.

The conclusion of the foregoing analysis is that humanity must abandon its pursuit of market fundamentalism and instead undertake a paradigm shift toward a novel nexus of economic rules, this time firmly aligned with planetary boundaries, namely natural limits, the laws of nature, and the rhythm of evolution. A closely related question that follows concerns the issue of governance. Specifically, how to govern (at both the macro and corporate levels) the key supporting fields of human activity, most notably big science, research and development, and education in ways that effectively advance the path of green transition. At the micro level, this implies building regenerative organizations across key sectors and industries, adapted to an era marked by resource scarcity and climate-neutral technologies. Such organizations must be capable of deploying solutions such as digital twins to identify ex ante failures in real-world production and consumption, while simultaneously translating insights generated by AI clusters into actionable information.

After all, the neoliberal model, as a conceptual platform for crisis mitigation, represents a manifestation of the "as-is" scenario for future development. What national economies, including Serbia, truly need is a "to-be" scenario based on the green transition.

The mission of each national economy during the green transition and its aftermath remains steadfast: to

provide an institutional framework, almost a sanctuary, that enables the effective use of growth drivers while fostering sustainable responses aligned with planetary boundaries, thereby contributing to well-being for all. Every transition represents a period of realignment. In this process, the energy and land-use sectors play a central role, shaping realignment across other industries with the objective of achieving climate-neutral industrialization.

Addressing multi-structural imbalances requires a systems-thinking approach. The new economy rests on two pillars: a circular and regenerative model of growth, as opposed to a linear one, and a heterodox economic policy platform, rather than an orthodox one, that integrates two complementary coordination mechanisms, the "invisible hand" of the market and the "visible hand" of the state [8, pp.12-14].

The heterodox economic policy platform provides the better balance between core economic policies (fiscal, monetary, competitiveness, employment, etc.) and an expanded role for structural (or industrial) policies. The concept of industrial policy is by no means uncharted territory. It has been firmly established in economic theory and, more importantly, in practice since the early 1960s. Prominent examples can be found among fast-growing late developers in East Asia, which pursued export-oriented industrialization strategies supported by technology transfer from developed countries. Over time, however, and despite robust growth, many of these economies entered the so-called "middle-income trap." Unfavorable terms of trade (relatively high prices for imported technologies and relatively low prices for exported goods), together with the dominance of second-generation industrial technologies, constituted key underlying causes. The real challenge was therefore to preserve export dynamism and job creation while simultaneously transforming the technological base of production. In response, these countries deliberately strengthened the role of the state in driving structural changes through targeted industrial policies. Beyond conventional commercial, fiscal, and monetary measures, the policy mix increasingly included investment in research and development and the deployment of new technologies as long-term drivers of competitiveness. In this way, these economies gradually moved from reliance on second-generation industrial technologies and cheap labor toward frontier technologies, accompanied by rising human capital intensity and the creation of higher-quality jobs.

In the most recent phase of the multi-crisis, there have been at least two attempts to rejuvenate the role of the state, not only in macroeconomic governance but also in industrial policy. The first is the policy platform advanced during the mandate of president J. Biden (Bidenomics), which emphasized new industrial and green policies. The second is the recently released EU Green Industrial Deal, formally expressed through the Antwerp Declaration [4].

Industrial policies are capable of addressing market malfunctioning in resources allocation, as well as failures of market coordination. Climate change is a broader form of market failure. Coordination failures typically arise when the implementation of new technologies requires complementary investments across entire supply chains, which are unprofitable when undertaken independently by individual actors. Last but not least, industrial policies also serve to facilitate the provision of customized public inputs tailored to specific sectors of the economy, yet not sufficiently distinct for private business agents to supply them on their own. A paradigmatic example is infrastructure, both physical and digital.

A key focus of industrial policies is the treatment of externalities, both negative and positive, namely, the effects that markets fail to price. Environmental externalities, particularly climate change, exemplify this failure. On the other hand, technological breakthroughs generate positive externalities, as do full employment and the creation of high-quality jobs. In the absence of industrial policies, resource allocations that generate negative externalities tend to be overproduced, while those associated with positive externalities are underproduced [40. p. 166].

Industrial policies function by directly correcting inefficiencies rather than through income redistribution. Although governments cannot successfully pick winners, they can prevent the continued support of losers. Taxes and subsidies are among the most effective policy tools for directly targeting the sources of externalities. Within the heterodox economic policy platform, these policy instruments play the role of automatic fiscal stabilizers. In the case of technological externalities and those related

to high-quality job generation, the prevailing instruments are subsidies. These subsidies may take various forms, including tax incentives, government grants, loans under preferential terms, and government credit guarantees. When the supported investments prove successful, such subsidies do not necessarily impose direct fiscal costs. Rather, the primary cost is indirect, arising from potential moral hazard.

Industrial policies require the embedded autonomy of the government bodies that design and implement them, combined with unrestricted information flows among economic agents and an iterative approach to problem-solving. Within such a system, state coordination cannot be top-down. Rather, it entails iterative collaboration [40, p. 212]. Specifically, this mode of decision-making is simultaneously safeguarded against rent-seeking by private economic agents and against hierarchical command-and-control by the state. Under this conception, the state assumes the role of a collaborative catalyst, a role long recognized in the literature on the "development state" [23]. Coordination between central and municipal levels of government follows a similar algorithm. Distilling these characteristics, C. Sabel and J. Zeitlin conceptualized this model of governance as "experimentalist governance" [41].

The concept that prioritizes both the green transition and the new industrialization, based on the diffusion of climate-neutral technologies across the economy, has been termed "productivism" by D. Rodrik [40, p. 155]. This concept prioritizes industrialization over financialization, production over consumption, and local development over globalization. At the same time, productivism departs from the Keynesian welfare state, often regarded as a historical predecessor to neoliberalism, by privileging the *ex ante* correction of market failures over *ex post* redistribution, and structural transformation over a reliance on social insurance and macroeconomic management alone. A sustainable and inclusive economy, oriented toward both people and nature, requires high-quality jobs and full respect for planetary boundaries. Advancing both objectives necessarily calls for supply-side interventions, specifically through structural (or industrial) policies.

Natural candidates for industrial policies are primarily found in tradable sectors, as sectors that substitute imports and/or expand exports. At their core, such policies aim to support productivity enhancement and output growth consistent with planetary boundaries and technological capabilities for regeneration. Conventional industrial policies were focused on manufacturing. By contrast, new industrial policies extend to digital upgrading across a broad spectrum of industries, encompassing both the real economy and service sectors, and are increasingly underpinned by AI-based tools and solutions, often described as a "platform economy" [6]. This conceptual shift places particular emphasis on contributive justice, rather than distributive justice. Contributive justice refers to the opportunities available to employees to participate meaningfully in value creation.

Macroeconomic automatic stabilizers, particularly in the fiscal and monetary spheres, enable the effective functioning of this policy platform. They provide alignment between macroeconomic policies and structural policies. Moreover, macroeconomic stabilizers can help offset the mammoth structural imbalances generated by the invisible hand theorem and steer the economy toward a trajectory of climate-neutral and sustainable growth. To fulfill this role, macroeconomic stabilizers must be designed and implemented in an experimental manner, based on iterative collaboration between economic agents and regulators. Such coordination cannot be exclusively top-down. Instead, it must integrate top-down guidance with bottom-up feedback, learning, and adaptation.

The foregoing components of the new system are key prerequisites for climate-neutral transformation of the energy and land-use sectors, as well as for the implementation of lifestyle changes in society grounded in the principle of reversibility, particularly in urban areas. Also, this framework also provides the context for a stronger and more effective role of industrial policies in economic development. Last but not least, the green transition, especially when driven by the catalytic effects of technological change, holds significant potential to mitigate the current output gap and address stagnating productivity levels.

At its core, the new policy platform combines market forces with an active role for the state in the economy. One important way of achieving this is through state impact

investment. Such investments are predominantly linked to horizontal industrial policies, notably infrastructure development and economy-wide support for tradable sectors. In addition, impact investments also encompass vertical industrial policies, primarily in science and technology, education, and health services, which indirectly strengthen the competitiveness of tradable sector.

Mitigation of the multi-crisis and economic recovery depend on innovation as the primary engine of both processes. Innovation, however, cannot be taken for granted by system architects, it must be purposefully shaped and effectively deployed through industrial policies, both horizontal and vertical.

Aligning scientific breakthroughs with eco-social well-being requires intentional governance rather than market-reactive governance, at both the macro and micro levels. To contribute to the green transition, scientific breakthroughs must be purpose-driven, scalable, and applicable to real-world challenges. Eliminating jobless recovery and reshaping employment structures toward a predominance of high-quality jobs and services are essential conditions for achieving full employment and equality in income distribution.

The previously identified pillars of the new economy are relevant components across all national economies, developed and developing, large and small, maritime and landlocked. Among fast-growing emerging economies, China stands out for eclipsing traditional Western powerhouses through the new industrialization. An original strategy aimed at achieving independence in rare minerals and metals, as well as in energy sources, established as early as 2003, has largely shielded China from the adverse effects of protectionism and other forms of geopolitical games. Also, Marocco offers another instructive example. Through targeted industrial policies focused on high-priority sectors (e.g. aerospace, semiconductors, renewable energy, and EV value chain) Morocco has succeeded in building sustainable competitive advantages.

The heterodox economic policy platform reaffirms a normative approach to planning oriented towards ecological civilization. Planning, in this sense, is not an act of prescribing what the future should be, but a disciplined process of identifying what must be undertaken in the present to secure a sustainable economy, society, and planet in the future. Accordingly, multiple pathways toward ecological civilization exist, reflecting the diverse trajectories through which national economies may create a sustainable economy, a peaceful society, and well-being for all.

Systemic governance of the green transition, along with the ethical renewal of human development, constitutes an essential dimension of further progress toward an ecological civilization. The planet does not merely require the preservation of finite resources. It needs regenerative mechanisms that are structurally embedded in new business models and modes of value creation.

The key question is which strategic priorities governments will pursue and how these priorities fit within fiscal capacity and fiscal rules across national economies. In any national economy, the energy and land-use sectors, by definition, as well as infrastructure, ICT, and agriculture, constitute key vectors for shaping a development strategy oriented toward an ecological civilization. Among these, energy is an absolute priority in the green transition.

Before elaborating on Serbia's green energy transition in greater detail, it is therefore necessary to assess the extent to which Serbia's economy has been prepared for this endeavor.

Serbia's Preparedness for the Green Energy Transition

Since the breakup of former Yugoslavia in the early 1990s, triggered by the fall of the Berlin Wall, Serbia has not experienced a prolonged period of genuine geopolitical stability. It is remarkable that the economy has managed to function for so long under conditions of persistent geopolitical pressures and internal political tensions.

Collective memory in Serbia has been profoundly shaped by the uprisings, economic sanctions imposed by Western countries during the breakup of former Yugoslavia, and the severe economic consequences of successive civil wars throughout the 1990s. This historical legacy helps explain Serbia's reluctance to impose sanctions on Russia, despite sustained pressure from the EU, toward which it

is formally converging. As a consequence, Serbia is an economy burdened by deep-seated structural imbalances, further intensified by enduring geopolitical pressures. Being perceived, explicitly or implicitly, as an "exotic" country, and excommunicated from leading EU trends, constitutes a far-from-ideal starting point for sustainable and inclusive development, particularly in infrastructure dominated by land-use and network technologies in general, and in the energy sector in particular.

Economic recovery commenced with the regime change in 2000. Unfortunately, this process was marked by numerous fault lines, overestimations, and misconceptions. In the aftermath of the Global Recession of 2008, an already vulnerable economy weathered several subsequent crises of lesser intensity, albeit accompanied by significant fiscal loosening. As a result, cumulative fiscal deficits led to a substantial increase in public debt, which reached 68.3% of GDP by 2015. Together with two additional macroeconomic imbalances (current account and capital), this situation prompted Serbia, in 2015, to recognize the necessity of entering a restructuring program with the primary goal of consolidating public finances. This step was essential to disentangle the effects of weak aggregate demand from the structural slowdown in potential supply growth.

During the fiscal consolidation program of 2015-18, sustained efforts to reduce public debt and rebuild fiscal buffers enabled a sizable countercyclical policy response. Following the successful completion of fiscal consolidation, policymakers gained the fiscal space to pursue growth-enhancing investments. State impact investments emerged in response to a clear need for large-scale infrastructure investment. At the same time, recurrent public expenditures, such as pensions, public sector wages, and social benefits, were maintained on an equal footing. Without renewed economic growth, however, these commitments would soon risk becoming unsustainable. Unfortunately, a side effect of this strategy was the widening of the current account deficit, reflecting an excess of investment over domestic savings. At its core, such a deficit can be considered benign when it results from elevated investment levels rather than insufficient savings. A further favorable aspect is that these investments have been largely productive, particularly in terms of export increase. The allocation of investment away from tradable manufacturing, toward non-tradable sectors such as housing, may be regarded as a necessary but potentially malign side effect of the recent investment surge.

Based on this dual-track approach, Serbia has risen like a phoenix from the ashes. The new policy mix has enabled pro-export industrial policies, particularly in the information and communication technology (ICT) sector and the automotive value chain. With regard to services, Serbia has been running surpluses in this segment of the current account, largely due to the expansion of ICT exports. The fiscal space created in this way has facilitated an adequate policy response to the subsequent four waves of the multi-crisis: the COVID-19 pandemic (2020-2022), the war in Ukraine (2022-present), the internal social crisis (2024-2025), and the energy security crisis (2025-present).

In mitigating the persistent global economic malaise and achieving recovery, core economic policies, primarily fiscal and monetary, played a critical role. The macroeconomic policy mix proved adequate, aligned with prevailing political realities, and complementary to new structural policies. Fiscal policy was purpose-driven (the annulment of the output gap as its primary focus), and evidence-based (the enforcement of hard budget constraints at both the macro and micro levels). Through a well-balanced combination of policy measures, including the broadening of the revenue base, with particular emphasis on reducing informality and reforming tax administration (over the entire period from 2015), cuts to pensions. public sector wages, and subsidies (2015-2018), subsequent increases in pensions and public sector salaries (from 2019 onward), wage furlough schemes during the COVID-19 lockdowns (2020-2022), the fiscal deficit declined to a historical low of 2% of GDP by 2024. In the same year, capital spending rose substantially, reaching a record high of 7.3% of GDP. Concurrently, the central bank succeeded in establishing a real interest rate consistent with a return to full employment under conditions of relative price stability. Monetary policy relied on two key anchors: a stable FX rate regime and a restrictive monetary stance.

Core macroeconomic policies were complemented by structural policies aimed at state impact investments in infrastructure and the tradable sector. As a result, this

policy mix contributed to the consolidation of public finance. Moreover, stronger macroeconomic fundamentals have provided a sound basis for investment, particularly foreign direct investment (FDI), which has contributed predominantly to financial system liquidity and growing investment risk appetite. In 2024, FDI inflows exceeded EUR 5.1 billion.

Based on this policy mix, Serbia has strengthened both its internal and external positions. Strong macroeconomic fundamentals, based on almost impressive fiscal consolidation program that subsequently evolved into an anti-crisis program, combined with a near-fixed FX rate, have provided a sound basis for macroeconomic stability and the stability of the financial system. While the fiscal system has remained resilient, the monetary system has developed some stabilizers aimed at limiting the need for more active discretionary monetary policy.

As inflation declined, macro liquidity increased and FX rate remained stable, investment (particularly FDI), growth, and earnings followed upward trends. These developments constituted a precondition for an increase in foreign exchange reserves, which reached a historic maximum, as well as for a continuous decline in the shares of public debt and the fiscal deficit relative to GDP. Collectively, these performances contributed to Serbia's first investment-grade sovereign credit rating, awarded by S&P in 2024, a logical response to the country's almost impressive macroeconomic fact sheet.

From a peak public debt-to-GDP ratio of 68.3% in 2015, Serbia's public debt has followed a sustained downward trajectory to the present day. By the end of 2025, general government public debt had declined to below 44% of GDP. Publicly guaranteed debt, covering the entire general government sector, stood at approximately 2.2% of GDP. In the same year, the budget deficit stabilized at around 3% of GDP. The fiscal strategy for 2026 envisages maintaining a fiscal deficit at this level in the coming years.

The strength of the industrial policy framework has been a key factor in shaping Serbia's strategic autonomy in a rapidly changing global economy. Traditional sectors such as construction, agriculture, and energy have all been identified as candidates for industrial policies. At the top of the priority list, however, has been the information and communication technology (ICT), particularly artificial intelligence (AI) [20]. During the ongoing multi-crisis, most countries have not been adequately equipped to accommodate massive and radical technology change. In contrast, public attitudes in Serbia have been relatively open to new technologies, especially AI. This openness can be attributed to active state involvement in the development of digital infrastructure (most notably data centers) and to a well-articulated industrial policy for the ICT sector. State engagement in AI development is expected to help narrow the gap with global hyperscalers. A key bottleneck in this process, however, remains the energy deficit associated with the high energy intensity of data centers.

Prior to 2025, Serbia exhibited an accelerated growth trajectory. The principal drivers of growth were FDI, consumption, and state impact investments. FDI has the potential to improve energy efficiency through technology transfer and capital upgrading [24]. Entering 2024, Serbia's economy demonstrated strong growth momentum, having expanded at higher-than-expected rates during the first three quarters of the year. Supported by solid macroeconomic fundamentals, Serbia's economic performance outpaced that of its regional peers within the Western Balkans Six (WB6), although it continued to lag behind its aspirational comparators in the Central and Eastern Europe Eight (CEE8) [52].

In the multi-crisis embedded in a highly unstructured, almost fluid, global economy, it is difficult to predict the momentum of engagement and the magnitude of impact of individual risk stressors. In 2025, Serbia's risk universe was increasingly dominated by social disputes and geopolitical interference. Immediately after Serbia received its investment-grade credit rating, social tensions sharply deteriorated the overall context and slowed growth ambitions. Owing to the momentum generated by prior development dynamics, however, the economy absorbed these new risk stressors with only moderate disruption.

More concretely, throughout 2025 social cohesion in Serbia was repeatedly tested by rising domestic political tensions, triggered by proponents of regime change. This movement, characterized by prolonged blockades of educational institutions at all levels, combined with *ad hoc* blockades of roads, railways, and public institutions, has

been supported by opposition parties and segments of the NGO sector. This part of society was evidently perceived the EU political and economic model as preferable to other geopolitical alternatives, including a stance of non-alignment. A key outcome of such activism has been the emergence of an autoimmune illness across key sectors of the economy and society.

Despite its limited political success, the social movement contributed to a deterioration of macroeconomic fundamentals. Transport, logistics, and hospitality sectors were severely affected. The key negative effect relates to opportunity costs (foregone income) resulting from a sharp decline in FDI. Moreover, the willingness to invest in an unstable environment has declined. FDI inflows declined markedly, falling from EUR 5.1 billion in 2024 to EUR 2.5 billion in 2025.

Instead of the forecasted growth rate of 3.5-4.0% set out in the budget projection for 2025, actual economic growth declined to around 2%. Because moderate-to-high growth was necessary to contain rising domestic political pressures, the government continued to pursue a pro-growth policy stance, while the central bank introduced certain supervisory adjustments. Remittances from the diaspora, representing a second important source of liquidity for the financial system, remained stable at roughly EUR 5 billion, thereby keeping insolvency risks at a manageable level. Core inflation remained somewhat more persistent than headline inflation, which has been gradually brought under control, reaching the target level of 3% ± 1.5%.

Despite (geo)political constraints, Serbia appears, in purely economic terms, to be locked into a growth equilibrium of around 2% at the end of 2025, well below the planned rate of 4%. The 2026 budget confirms that the fiscal stance and outlook for the coming year remain sustainable. Downward trends in public debt and the budget deficit are expected to persist, while the growth forecast for 2026 stands at 3-3.5%. These projections have been endorsed by IMF/WB. These multilateral institutions also have an important role to play in de-risking investment in Serbia, particularly in the green energy area. Household savings, together with foreign exchange and gold reserves as forms of state-level savings, remain at respectable levels. Under these conditions, the current account deficit suggests not that investment is insufficient, but rather that savings are excessively high. Accordingly, the Ministry of Finance, in the 2026 budget, has acknowledged the need to stimulate consumption, not only through investment, but also through final consumption measures, including pension increases and strengthened social safety nets, which are expected to release precautionary savings.

In the near future, stronger economic growth is desirable for many reasons. In a country such as Serbia, however, the most important rationale for moderate-to-high growth is intergenerational equity, particularly given that future generations will bear the burden of servicing obligations incurred by their predecessors. Serbia's ability to return to a stronger growth trajectory, without additional fiscal support, will largely depend on the continuation of the EXPO project as a flagship initiative within a broader portfolio of infrastructure investments.

Despite a relatively strong baseline, Serbia faces several important risk stressors that warrant careful attention. First and foremost, public debt remains vulnerable to potential depreciation of the RSD, given that approximately three quarters of it is denominated in foreign currency. This vulnerability is compounded by contingent risks arising from the large footprint of state-owned enterprises (SOEs) in network technologies and natural monopolies, particularly in energy, telecommunications, and utilities, which play a significant role in GDP formation. The state sector remains relatively large. Total budgetary expenses amount to roughly 43% of GDP, a level broadly comparable to that of aspirational CEE8 economies and WB6 comparator countries. In this context, the restructuring of SOEs and governance based on corporate governance principles are critical to safeguarding the current fiscal health and to maintaining macroeconomic and financial system stability.

Another significant vulnerability is associated with systemic risk stressors, including the consequences of extreme weather events (floods, droughts, and heatwaves, etc.), as well as the nexus of risks stemming from a slowdown in global economic activity (with IMF projections indicating global growth of 3.1% in 2026) and rising inflationary pressures at the global level. Last but not least, while integration with the EU has generated numerous positive

effects, it has also amplified certain adverse effects, notably Serbia's exposure to regulatory shifts such as the Carbon Border Adjustment Mechanism (CBAM), particularly for carbon-intensive export sectors.

The green transition is a panacea. A critical component of Serbia's green transition is the transformation of its energy sector. In any development strategy, the economy ultimately depends on energy security, which in turn requires reliable and abundant energy supply across multiple sources and forms.

Without energy security, Serbia risks becoming locked into a destabilizing pattern of output compression. This is a huge puzzle. Namely, a persistent output gap undermines fiscal balances, while the predominance of foreign-held public debt heightens exposure to credit crunch. Any depreciation of the RSD would rapidly translate into heightened inflationary pressures.

In the energy sector, systemic weaknesses persist and continue to pose substantial contingent liabilities for public finances. Consequently, a comprehensive reform agenda for SOEs in the energy sector remains essential to addressing long-standing structural imbalances while containing significant fiscal risks and costs. For example, according to the World Bank [52], the 2022 energy crisis alone resulted in subsidies, bailouts, guarantees, and forgone revenues amounting to 2.2% of GDP.

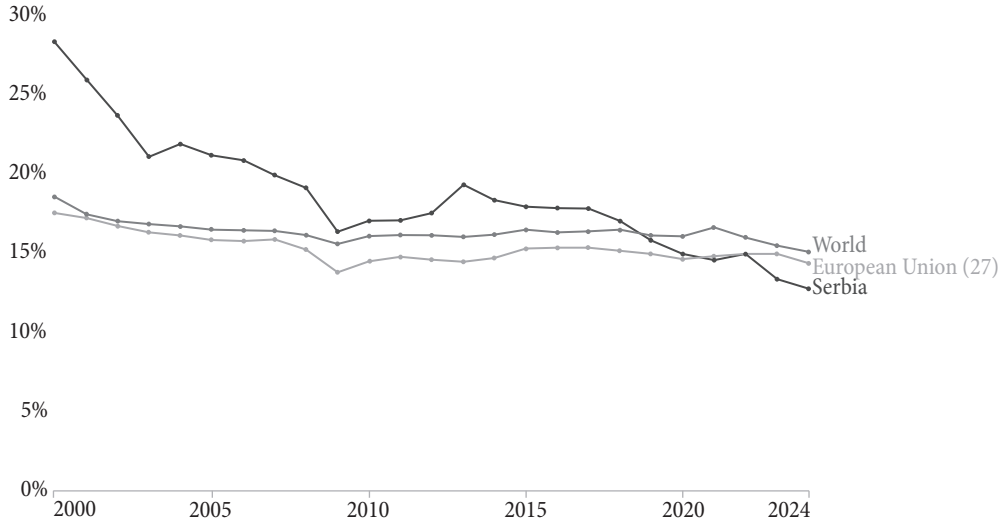
The green energy transition, aimed at offsetting the adverse effects of climate change, mitigating fiscal risks arising from the current business model and governance practices of state-owned enterprises (SOEs), and, on this basis, unlocking growth potential, is indispensable for the survival of Serbia's energy system. Persistent strategic misalignments rooted in coal-based energy production, low operational efficiency, and the inadequate enforcement of hard budget constraints within highly indebted SOEs call for urgent and decisive policy interventions. At the same time, pricing policies should be adjusted to more accurately reflect cost recovery, complemented by well-targeted social policies to protect vulnerable segments of society. These reforms must remain fully consistent with Serbia's fiscal framework, including the statutory ceiling on the public sector wage bill set at 10% of GDP; in 2024, this ratio stood at 9.4%.

All in all, the momentum for the simultaneous phase-in of renewable energy technologies and the phase-out of fossil fuel technologies has arrived.

Addressing Impediments to Growth through Investment in Renewable Energy

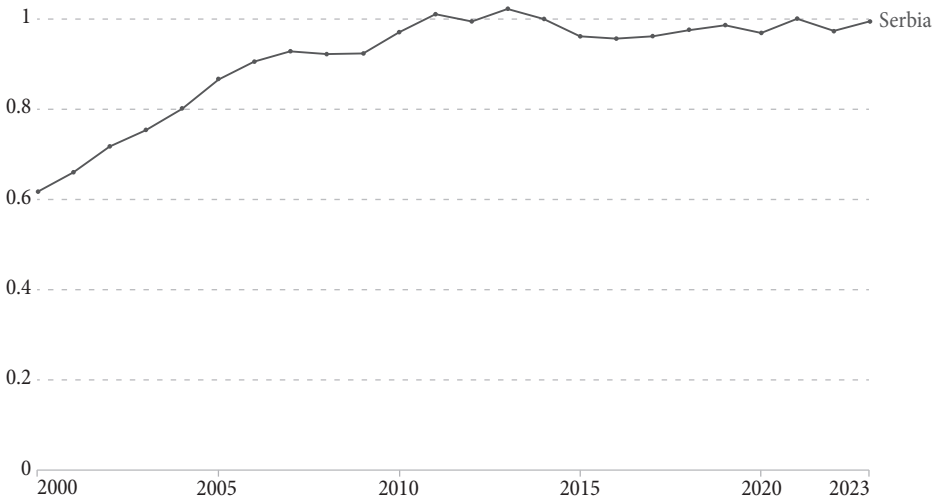
Key drivers of growth are output, typically measured by GDP, and productivity, usually measured as total factor productivity (TFP). In the case of Serbia, a relatively low share of manufacturing in GDP formation is a key limit to growth. This share has fallen below the world average and even below the EU average (Figure 4). Consequently,

Figure 4: Share of Manufacturing in GDP for the World, the EU, and Serbia, Period: 2000-2024



Source: Our World in Data, based on national statistical organizations and central banks, OECD national accounts, and World Bank staff estimates [34]

Figure 5: Total Factor Productivity in Serbia, Period: 2000-2023



Source: Our World in Data, based on Feenestra et al. – Penn World Table (2025) [35]

value added in the real economy falls short of GDP growth, disproportionately exposing the country to risks arising from global financial markets.

Along with extensive output growth, TFP has remained largely stagnant for more than a decade [32, p. 5]. Figure 5 illustrates the stagnation of TFP over the period 2000-2023. Serbia's TFP gap relative to its aspirational comparators (CEE-8) is primarily a consequence of the investment structure, which has been dominated by state impact investments in infrastructure and export-oriented FDI concentrated in low- to medium-technology activities. In addition, a substantial gap persists in labor productivity, further constraining overall productivity performance.

Taking into account that productivity in modern industry is largely determined by the availability and use of energy, as well as by the structure of energy sources, it makes sense to shed light on energy use in Serbia as follows. First, the volume of energy available for consumption per capita (p.c.) in Serbia does not lag far behind the EU average. Namely, the gap of about 17 p.p. shown in Table 1 is certainly much smaller than the corresponding gap in GDP p.c.

Second, energy productivity in Serbia increasingly lags behind the EU average. GDP generated per unit of energy in Serbia is nearly 3.8 times lower than in the EU. To make matters worse, the EU has exhibited a clear trend of significant improvement in energy productivity, whereas Serbia has achieved only a modest increase in its energy productivity (Table 2).

Third, even more concerning is the dramatic increase in Serbia's net energy imports over the past decade, while energy imports in the EU have grown only modestly. As a result, Serbia is becoming increasingly dependent on energy imports, despite the evident rise in geopolitical risk (Table 3).

Fourth, it is interesting to compare the structure of energy sources in Serbia and the EU. Serbia's energy

Table 1: Gross Inland Energy Consumption, 2013-2023 (kg of oil equivalent p.c.)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EU	3,350	3,230	3,271	3,291	3,356	3,329	3,269	2,998	3,189	3,037	2,904
Serbia	2,080	1,869	2,081	2,181	2,237	2,218	2,214	2,303	2,362	2,417	2,404

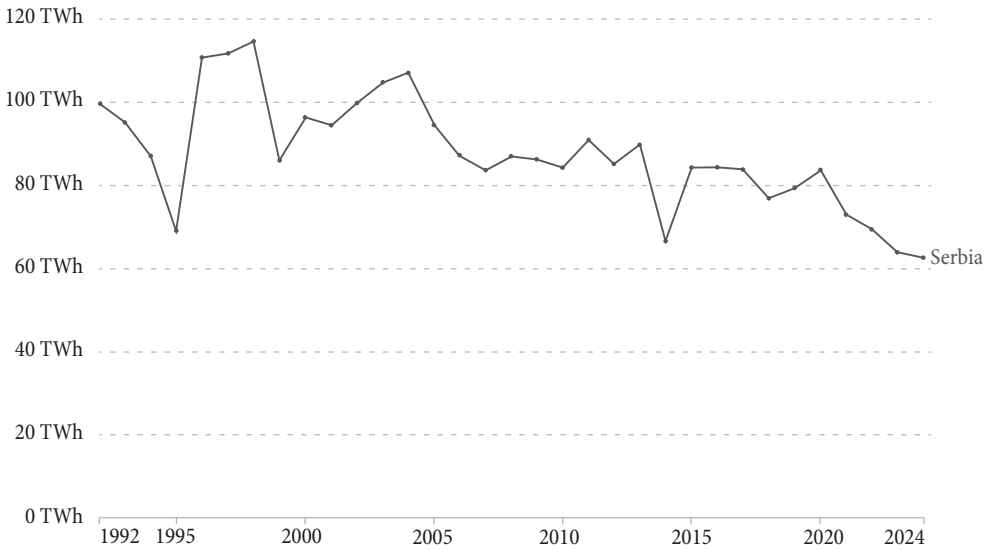
Source: Eurostat Database

Table 2: Energy Productivity, 2012-2022 (GDP in EUR per kg of oil equivalent)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
EU	7.3	7.3	7.7	7.8	7.9	7.9	8.1	8.4	8.7	8.7	9.4
Serbia	2.2	2.2	2.4	2.2	2.2	2.2	2.3	2.5	2.4	2.5	2.5

Source: Eurostat Database

Figure 6: Lignite Production in Serbia, in Energy Terms (TWh), Period: 1992-2024



Source: Our World in Data, based on Energy Institute – Statistical Review of World Energy (2025); The Shift Data Portal (2019) [33]

sector is dominated by solid fuels, primarily low-quality lignite coal (Table 4).

In terms of physical volume, lignite production in Serbia has maintained a similar level for years (35-40 million tonnes). However, domestic lignite production declined to 31 million tonnes in both 2023 and 2024 [11, pp. 13-14], signaling a sustained downward trend. Moreover, the energy content of domestic lignite has continued to deteriorate. There has also been a slight reduction in overburden removal (from106 million m^3 to 104 million m^3), while the lag relative to the sustainable overburden-to-lignite ratio of 3.5:1 seems to be persistent. Figure 6 illustrates the longer-term trend in lignite-based energy production, measured in TWh.

Meanwhile, other regional peers (WB6) have struggled to maintain physical output from key lignite mines. As a result, it has become increasingly difficult to offset lignite shortages through cross-border trade within the region. Consequently, Elektroprivreda Srbije (EPS) has turned to steam coal imports from seaborne markets. This represents a major new contributor to Serbia's trade deficit[1].

1 According to the Statistical Office of the Republic of Serbia, the trade balance in coal turned negative in 2023 and 2024, amounting to EUR 650 million and EUR 439 million, respectively. Beyond coal imports, imports of oil and oil products generated a trade deficit of nearly EUR 2 billion per year, while natural gas imports contributed an additional EUR 1.0-1.2 billion annually. In total, the energy-related trade deficit amounts to about EUR 3.5 billion per year, accounting for more than 40% of Serbia's overall trade deficit. Furthermore, lucrative electricity trading, based on the strategic use of hydropower to acquire surplus and off-peak electricity from the region while supplying high-value peak electricity and grid-stability services to the rest of Europe, generated a net gain of EUR 490 million in 2023, but only EUR 32 million in 2024.
In a similar vein, by combining data from energy balancing statistics and balance-of-trade records, it can be observed that in 2023 Serbia imported crude oil and oil products at an average price of EUR 51.8/MWh and natural gas at EUR 51.5/MWh, despite the fact that the European spot market price for natural gas (TTF) averaged around EUR 38/MWh and remained relatively stable following the turbulent year of 2022.

Table 3: Net Energy Imports, 2013-2023 (Index, 2013 = 100; based on tonnes of oil equivalent)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EU	100.0	97.4	101.7	102.9	107.6	108.2	110.8	96.7	99.0	106.5	95.3
Serbia	100.0	103.7	114.0	127.5	148.0	149.5	152.6	133.1	156.9	204.9	186.0

Source: Eurostat Database

Table 4: Primary Energy Production by Source, 2023 (% of Total Primary Production)

	Crude oil and petroleum products	Solid fuel	Gas	Nuclear heat	Renewables	Non-renewable	Other sources
EU	3.4%	13.7%	5.3%	28.6%	46.0%	2.4%	0.7%
Serbia	9.3%	57.9%	2.6%	0.0%	30.1%	0.0%	0.0%

Source: Eurostat Database

Steam coal import prices have also been weighing on TFP. In 2023-2024, prices (CIF) at the Amsterdam–Rotterdam–Antwerp (ARA) ports and prices at the Qinhuangdao port (FOB) ranged between USD 96 and 100 per tonne for coal with a calorific value of 6,000 kcal/kg [14]. Freight costs from Australia's Newcastle port to the ARA ports amounted to approximately USD 14 per tonne [13]. Taking into account the calorific value of Serbian lignite, ranging from 1,400 to 1,900 kcal/kg, and FX USD/EUR, it turns out that equivalent price of Serbia lignite is to be less than EUR 18 per tonne[2]. The sales price of lignite from EPS open-cast mines is roughly consistent with this level. However, the Australian coal industry has consistently generated outstanding returns[3] well above average returns [31] while providing substantial revenue to public budgets[4]. By contrast, lignite mining in Serbia requires both continuous and emergency state aid interventions, provided in cash and in kind, to sustain production. Additional contributors to low productivity include the structure and age of machinery, governance shortcomings, high maintenance and health-related costs, environmental damage to property resulting from extraction, financing costs, and related factors.

Comparing prices per unit of energy in Serbia with those of global leaders reveals that coal mining in Serbia and Australia generates a dramatic divergence in TFP and profitability. While some improvements in Serbia are certainly possible, they are unlikely to be sufficient to deliver the massive gains in factor productivity required to close the gap with peer economies.

An additional problem is the inadequate efficiency of lignite conversion into electricity. Transformation losses in Serbia's energy sector have grown into a major impediment to investment in the existing industrial structure. Figure 7 shows the ratio between primary energy consumption (PEC) and final energy consumption (FEC).

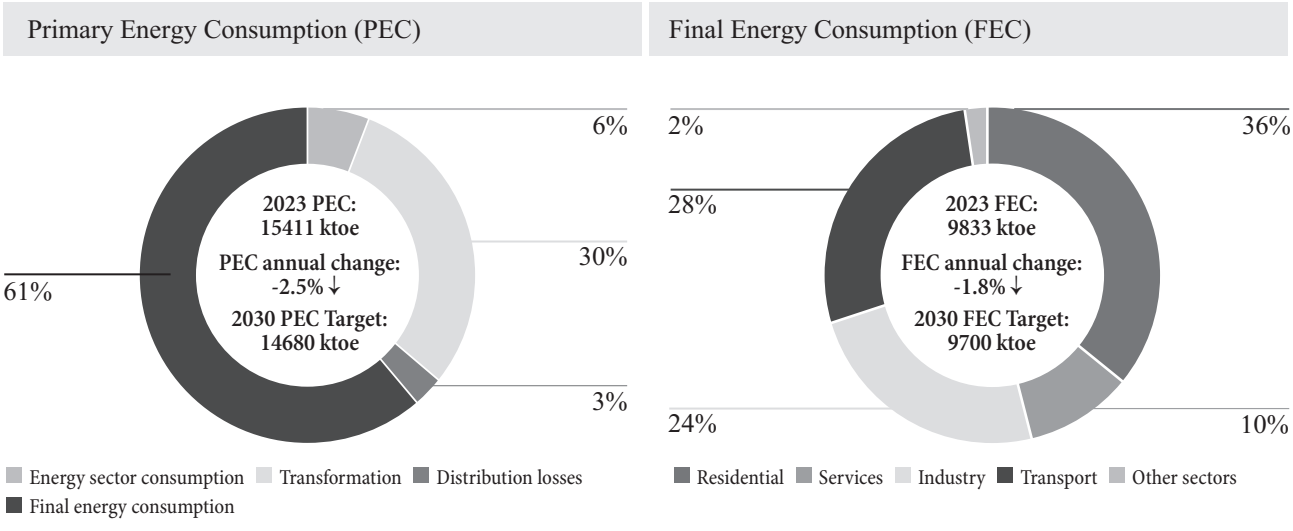
The reported ratio shows that energy transformation efficiency in 2023 stood at only 63.8% and was further reduced to 61% after accounting for distribution losses. This is the share of primary energy that was transformed and made available for final consumption. Of this amount, 36% was consumed by residential customers, 10% by services, 24% by industry, and 28% by transport. Consequently, only 14.6% of primary energy consumption (PEC) in Serbia was ultimately delivered for industrial use. Moreover, Serbia's National Energy and Climate Plan (NECP) envisages a reduction in both available PEC

2 Even though that lignite is not traded on international markets [15].

3 Look, for example, [49].

4 In Australia, coal mining "concession fees" are implemented primarily through state-level royalties rather than a separate federal charge. In New South Wales, coal royalty rates are set at 10.8% for open-cut operations and around 9.8-8.8% for underground mines, based on the value of coal recovered. In Queensland, a progressive royalty regime applies, with effective rates increasing with the average coal price, typically around 20% under current price conditions and rising to 30-40% at high price bands. Western Australia's export coal royalty sits around 7.5 % of value. These royalties represent the principal ongoing concession cost for coal producers in Australia (see further details in [37]).

Figure 7: PEC/FEC Ratio: 2023 Level and 2030 Target



Source: Energy Community Secretariat [12, p. 155]

and FEC by 2030, alongside only a slight improvement in energy transformation efficiency, to approximately 66%.

In advancing the green energy transition, it is possible to distinguish between domestic resources, which may deliver outstanding productivity of capital and labor, and imported resources, which are more likely to facilitate only moderate factor productivity. Ceteris paribus, high levels of technological standardization and economies of scale are critical for minimizing capital expenditure. This, in turn, requires partnerships with global technological leaders capable of enabling the green transition, industrialization based on climate-neutral technologies, grid optimization, and the realization of economies of scale.

With respect to biomass and geothermal energy as primary renewable sources, the focus should be placed on leading-edge technologies meeting high standards of TFP and profitability. These sustainable energy alternatives offer high utilization rates of both invested capital and existing infrastructure. Serbia clearly possesses competitive advantages in both energy sources, as well as a strong incentive to maximize the use of existing infrastructure, including massive district heating infrastructure that currently operates below 1,000 equivalent full-load hours.

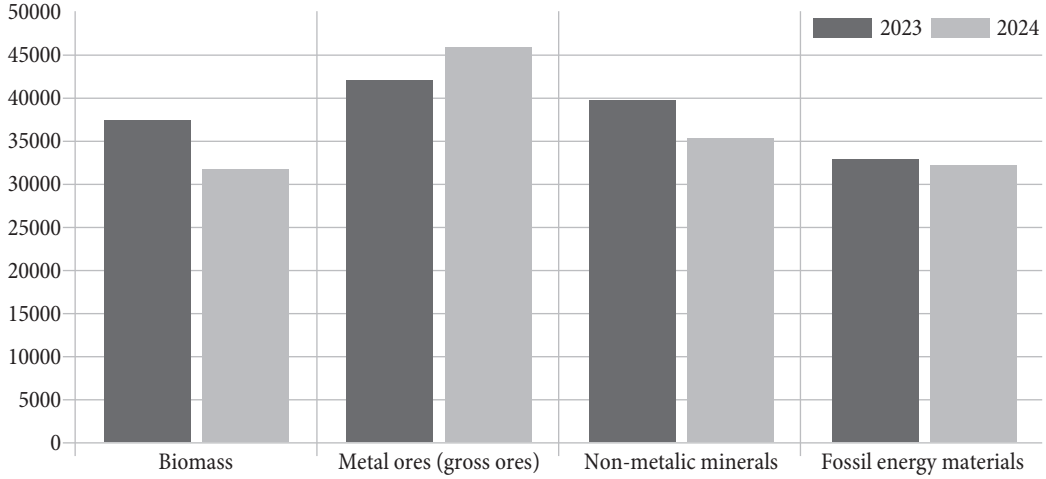
Serbia has substantial endowments of natural resources. Fossil energy materials are dominated by lignite extraction. The solid line in Figure 8 indicates the volume of biomass extracted in Serbia, expressed in energy-equivalent terms and comparable to the total volume of lignite extracted in the country.

Domestic biomass production in Serbia has respectable extraction potential. This potential is underpinned by extensive state-owned land located along major river corridors (most notably the Danube and the Sava) as well as by favorable water and solar endowments across the territory. In addition, Serbia's transport infrastructure enables the efficient aggregation of large volumes of low-energy-density biomass at a handful of processing locations, where economies of scale and technological standardization can be leveraged to maximize factor productivity. This model is particularly feasible given Serbia's outstanding combination of inland waterways and a well-developed electrified railway infrastructure.

Domestic biomass in Serbia is either extracted and used for residential heating at very low efficiency or not utilized at all, remaining neglected as a source for industrial-scale energy production. Bringing unused land into productive use or increasing yields on existing land would have effects comparable to activating underutilized infrastructure [21].

The authors of this paper have created a portfolio of homegrown renewable energy investments for the period 2025-2035, designed to combine the systematic phase-in of major renewable energy sources with the orderly phase-out of fossil fuel-based sources (Table 5). Estimations are based on the Eurostat Data base Sankey Development tool applied to Serbia 2023 energy data [16]. This portfolio is intended to underpin sustainable economic development by fundamentally improving the efficiency and structure of

Figure 8: Domestic Resource Extraction by Category (thousand tonnes)



Source: Statistical Office of the Republic of Serbia [44]

energy use. Specifically, it increases the conversion efficiency from the current PEC level of 61% to a target FEC level of 85%, while simultaneously expanding total electricity generation and increasing the share of commercial and industrial energy consumption from 32.5% to 46%. These structural shifts are projected to reduce the trade deficit arising from energy imports by one half.

The previously mentioned portfolio of projects in power and/or heat generation based on renewable energy sources is a critical prerequisite for the following effects:

1. Consolidating macroeconomic achievements from the previous period;
2. Improving TFP and profitability of investments at the macro level;
3. Minimizing energy security risks and removing energy-related impediments to future development;
4. Reducing dependency on energy imports and the associated geopolitical implications;
5. Strengthening macroeconomic balances through electricity surpluses and green financing;
6. Increasing aggregate supply by doubling the volume of electricity available for domestic consumption;
7. Sustaining the technical prerequisites for an investment-grade credit rating as a prerequisite for high-volume, long-term energy investments (e.g., nuclear power);
8. Mitigating climate-related risks over time;
9. Improving public health outcomes through reliance on renewable energy sources;
10. Advancing Serbia's accession to the EU.

Apocalyptic consequences will occur if Serbia postpones the implementation of the proposed portfolio of investments.

Table 5: Investment Portfolio for a Homegrown Renewable Energy System, Period: 2025-2035

#	Project Class	Power & Heat capacity (MWe; MWt)	Fuel	Investment (million €)	Investor	Estimated electricity production	Estimated heat[5] production
1	Biomass heat and power plants	Power: 3,000 MWe Heat: 4,800 MWt	Biomass	7,840	EPS	21,000 GWh	10,560 GWh
2	Methane power plants	Power: 800 MWe Heat: 1,200 MWt	Domestic Natural gas, methane, bio-methane, e-methane	800	EPS	4,800 GWh	
3	Waste-to-energy plants with recycling facilities	Power: 192 MWe Heat: 480 MWt	Combustible waste, more than 50% biogenic	1,160	EPS	1,536 GWh	1,000 GWh
4	Wind power	Power: 4,000 MWe – 6,000 MWe	Wind energy	5-6,000	Private	6,000 GWh	n.a.
5	Solar power	Power: 2,000 MWe – 3,000 MWe	Solar energy	2,000	Private	3,360 GWh[6]	n.a.
6	Existing lignite power plants	350 MWe	Lignite	Existing	EPS	2,450 GWh	-
7	Existing hydropower plants		Hydro power	Existing	EPS	11,000 GWh	132 GWh
8	Geothermal	1,800 MWt	Geothermal heat	Unknown	Private	-	14,400 GWh[7]
Total dispatchable		Power: 3,780 MWe Heat: 6,240 MWt	98% Biogenic renewable	9,540	EPS	40,786 GWh	26,092 GWht
Total variable		6,000-9,000 MWe	Renewable	>7,000	Private	9,360 GWh[8]	-
Total energy						**50,146 GWhe**	**26,092 GWht**

Source: Authors' estimates

5 Actual heat production by district heating systems in Serbia in recent years (2020-2024) ranged between 6,000 and 7,000 GWh, with an installed heat production capacity of 6,551 MWt. Heat losses in 2024 exceeded 11%.

6 The estimate covers only solar power capacity that could be achieved through engagement between EPS and its final customers. Private investments, including those based on industrial power purchase agreements, self-consumption schemes, and similar arrangements, are not included in this estimate, as such investments are assumed to remain unchanged across alternative scenarios.

7 High-grade heat delivered for end use.

8 This volume of intermittent renewable energy is feasible, as the energy system envisaged here will be capable of providing robust system balancing for volumes of intermittent renewable energy many times larger. As a result, the energy system remains stable and capable of exporting balancing services to the wider European market.

Conclusion

Previous achievements represent a quantum leap beyond the current context. This is critical because the key fractures of the multi-crisis in which we are living, such as the climate emergency, unlimited financialization, income and wealth inequality, rising indebtedness, escalating costs driven by biotic feedback loops, and continually shifting sources of competitive advantage shaped by geopolitical actions and counteractions, are exerting pressure across every corner of the global economy. Conflicts with nature, as well as tensions embedded within the human-made socio-economic system, have reached epic proportions. The multi-crisis therefore requires a multifaceted transition based on complex structural change and multiple realignments, commonly referred to as the "green transition." In an economy that aspires to be sustainable, alongside the time value of money, creating the well-known compound rate of return, the compounding of natural returns and human well-being should serve as criteria of success, too.

The green transition is the pathway through which the economy and society can move from the "new normal" toward a "better normal," or a more balanced and sustainable normal. It is the means by which planetary balances can be restored. At its core, it entails a substantial reduction in carbon-based greenhouse gas emissions, along with the transformation of carbon from its gaseous state into solid (eventually liquid) forms of carbon that can be used for productive purposes. This transformation must be both environmentally sound and economically rational, thereby enabling climate-neutral industrialization.

According to the paradigm of an "open world," a world without planetary boundaries, the economy's productive potential is assumed to be unconstrained. This assumption provides the pretext for the linear model of growth and the shareholder value maximization theorem. However, in the more realistic paradigm of a "closed world," such as the one we inhabit, the only feasible path is to pursue a sustainable growth trajectory that respects planetary boundaries. This condition constitutes a prerequisite for a circular and regenerative model of growth that also respects the interests of all stakeholders.

Belief in an open-world paradigm is a key driver of multilateral trade and investment. Even during periods of economic boom, no national economy engages in global trade and investment solely for its own benefit. During the bust stage of the economic cycle, the primacy of collective interest becomes even more evident. In the context of a multi-crisis, there is growing awareness that the global socio-economic system stands at a crossroads: between retreat and renewal, deglobalization and a new form of globalization, an economy shaped by militarization and one guided by economic reasoning, and between a strength-based international order and a new world order inspired by the sustainability of the economy, society, and the planet.

At a time when humanity faces multiple and overlapping turbulences, leadership grounded in actionable knowledge of how to conduct the green transition and implement climate-neutral industrialization is not merely important, it is indispensable. In this multi-objective endeavor, the green energy transition offers a first step toward restoring confidence that prosperity within planetary boundaries, and the compatibility of the socio-economic system with natural sub-systems (both physical and biotic), are both feasible and enduring.

The green transition policy mix is designed to provide clear signals to the energy and land-use sectors regarding investment priorities and pathways for addressing the climate emergency. This policy mix combines market-based instruments, such as carbon trading systems, with tax policy measures, including carbon taxes and subsidies for emissions reduction, as well as state impact investments in energy infrastructure, such as grid optimization. In parallel, these measures are complemented by alternative financing mechanisms, including green loans, green bonds (both sovereign and private), state guarantees, etc.

Through the green transition, understood as a pivotal juncture in the shift toward a so-called "ecological civilization," based on the restoration of climatic and ecological integrity within the socio-economic system, Serbia can and should position itself as a provider of sustainable development for its citizens while contributing to global well-being. In an increasingly competitive global race for resources, small countries lack the capacity to

withdraw from existing supply chains or to achieve energy diversification independently. A feasible alternative lies in the continuous and strategic use of domestic renewable resources, particularly in the energy and land-use sectors. The green energy transition is therefore a precondition for a circular model of growth and for a heterodox economic policy platform, with industrial policy at its core, capable of delivering long-term sustainability.

In search of an adequate response to the challenges of the green transition, what should Serbia do in terms of strategic autonomy, ultimate objectives, and policy options?

First and foremost, Serbia should and is expected to strengthen effective responses to the climate emergency as a global challenge. If humanity intends to remain on the planet indefinitely, the socio-economic systems of national economies cannot ignore Paris-aligned targets, climate stress indices, and SDG/ESG-related benchmarks. So, the phase-out of fossil fuel-based technologies has become imminent. In energy and land-use sectors, Serbia really needs a clear strategic reorientation rather than continued reliance on fossil energy sources, especially lignite. An encouraging factor in this turnaround from fossil to renewable energy sources is Serbia's macroeconomic preparedness, notably its fiscal space and monetary stability, enabling the financing of green energy investments. Macroeconomic fundamentals fuel cautious optimism, despite low growth of 2.0% in 2025. The economic contraction proved less severe than expected following the social malaise of the previous year. The budget has slipped into a deficit of 3%, while the debt-to-GDP ratio has gravitated toward 40% and is slightly declining. Inflation remains within the target band (3% ± 1.5%).

Second, in future energy production, Serbia must outcompete fossil fuels by relying primarily on nature-based solutions, such as afforestation and geothermal energy. A solar boom is evident in China, while wind energy and hydrogen technologies are particularly prominent in the EU. In Serbia's medium-term horizon, biomass and geothermal energy are seen as the most potent homegrown renewable energy sources. Over the longer term, nuclear energy is likely to become the most powerful, and most demanding, in terms of investment and expertise, energy source. To accelerate the green transition, all renewable energy technologies, together with grid optimization, carbon capture and utilization, and emerging infrastructure technologies such as 4IR/AI tools, can operate synergistically when strategically coordinated through industrial policy.

Third, in the green energy transition, the policy mix is critical. Medium-term policy measures are likely to have a constrained impact on the forces shaping the sustainable prospects of Serbia's economy. Among short-term instruments, carbon pricing remains the most essential tool for addressing climate change and constitutes an integral element of the EU regulatory framework (CBAM). Beyond incentivizing renewable energy deployment, carbon pricing also functions as a powerful criterion for project selection, helping to identify potential losers and uncertain winners. Long-term project selection measures, in turn, help to align high-priority green investments with appropriate green financing instruments.

Fourth, it is particularly important that the green energy transition be tightly integrated with climate-neutral industrialization. Demand for rare metals and minerals used in green energy production (primarily lithium, cobalt, and copper) has surged. Consequently, the mining industry is likely to benefit from the green transition. In the energy and land-use sectors, opportunities for upgrading products/technologies through combinatorial innovations are endless. Tools and solutions associated with 4IR/AI can help restore a renewed sense of purpose by expanding the scope of what is ecologically and economically conceivable. At the same time, even under a carefully calibrated mix of industrial policies, it is important to remain realistic: double-digit growth rates achieved by East Asian economies in the late 1960s and by China during the 2010s are unlikely to be replicated in the future. The expansion of the export-based real economy is increasingly constrained by planetary boundaries, while services-based growth lacks the growth-multiplying capacity traditionally associated with real-economy expansion. Moreover, AI-based clusters rely on energy-intensive data centers and semiconductor production, assets that tend to face technological obsolescence over the medium term (mostly within a three-year period). As a result, the energy and land-use sectors remain the

principal domains of investment capable of sustaining medium-to-high growth over the longer term, particularly when based on local resources.

Fifth, across all the aforementioned activities, industrial policies, both horizontal and vertical, play a critical role. Together, these policies can ensure sufficiently robust carbon price and/or equivalent cap-and-trade mechanisms, provide targeted subsidies for innovation in green energy technologies, and mobilize a critical mass of financial resources through green financing instruments. Also, for innovation-driven positive external effects, venture capital is of particular importance in supporting early-stage technological development and scaling.

Last but not least, geopolitical (re)positioning and its economic footprint also matter for accelerating the green transition and boosting sustainable economic growth. Geoeconomics and geopolitics are, in this respect, Siamese twins. In times of overall prosperity, the doctrine of safeguarding the nation by preserving national independence provides the rationale for the existence of the nation-state. The root cause of this standpoint lies in the will of the people, complemented by geography, primarily maritime status, and the deposits of ultimate resources, particularly energy resources. In periods of regression, however, political will alone is insufficient to sustain such a mindset. In the absence of critical resources and the logistics required to secure them, economic activism offers limited leverage. In a world in which geopolitics dominates economic reasoning, maintaining economic activism intact becomes extremely difficult, if not impossible. The will of the people is not sufficient to ensure nonalignment. It is much more important to whom you are connected than who you are. In an increasingly fragmented and highly fluid global environment, marked by a roller coaster of multi-crisis dynamics and profound geopolitical shifts, the national economy is increasingly expected to be self-sufficient. Whether this is fully achievable remains uncertain: perhaps "yes," perhaps "no," but most likely, "yes."

In the final stage of a unipolar world, explicitly referred to as a "rules-based order," the dominant geopolitical logic has implicitly assumed a binary form: "with us or against us." This rule of thumb is particularly challenging for countries with a tradition of non-alignment, reflected in resistance to various forms of external pressure aimed at creating and sustaining specific cooperative political regimes, including the extreme case of a "client state." In theory, multilateralism offers an alternative through which countries with a strong independentist mindset can preserve their embedded geopolitical standing without penalizing access to strategic resources, state-of-the-art technologies, and export markets. Unfortunately, multilateralism remains at an early stage of development and has yet to reach the status of a fully operational and reliable platform. For a country such as Serbia, a small, open, landlocked, middle-income economy lacking a critical mass of strategic resources and positioned on a convergence path toward the EU, the key challenges are how to avoid a "stuck-in-the-middle" position, preserve strategic autonomy, primarily in the form of energy security, and integrate meaningfully into global value chains despite structural constraints.

In an emerging "rule-of-strengths order", particularly during a rolling crisis, the impact of geopolitics on energy security is an external asymmetric shock with strong, multiple, and mostly delayed effects on macroeconomic stability. In laying out the road ahead, a growing awareness of economic realities will generate the need for more active geopolitical engagement. The NIS saga colorfully explains this point. Without energy security, Serbia risks becoming locked into a problematic trajectory of progressive output squeeze. As growth slows, inflation reaccelerates. The aggregate effect would be a deterioration of macroeconomic fundamentals, particularly through the deepening of fiscal, current account, and capital account imbalances. Moreover, Serbia could easily enter a credit crunch, given that its debt is predominantly held by foreign investors. This creates a complex puzzle, placing sustained pressure on FX rate, one of the key anchors of macroeconomic stability and credit rating. To avoid such a negative chain of events and remain on a green energy transition trajectory, the preservation of trust, dignity, optimism, and strategic agility at the state level is critical. This will require sustained attention in the period ahead. It is more than a showcase; it is a statement of intent.

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Dragan Đuričin

is a fellow of the World Academy of Art and Science and a member of the UNESCO Advisory Committee for the International Decade of Science for Sustainable Development. He is a professor of Business Economics and Management, including Strategic Management, Project Management, Enterprise Risk Management, Economics of Strategy, and Strategic Financial Management. He is editor-in-chief of the Serbian scientific journal Economics of Enterprise. He is president of the Serbian Association of Corporate Directors. He has authored dozens of books in the fields of strategic management, project management, systemic transition, and risk management. He was a visiting professor at the University of Venice as well as a fellow of the Fulbright Foundation. He was a member of corporate governance bodies in a dozen multinationals and reputable Serbian corporations, including Tarkett, Molson Coors, Danube Foods Group, Addiko Bank. He worked at Deloitte for 24 years, holding C-level positions, including Chairman of Deloitte Pannon Adria. He served as Chair of the Supervisory Board of Dedinje Cardiovascular Institute. Currently, he is a member of corporate governance bodies of Metalac, Messer Tehnogas and NLB Komercijalna banka. He was a founder and executive chairman of the Kopaonik Business Forum. He was president of the Serbian Association of Economists for fifteen years. He was a member of the Economic Council of the Government of the Republic of Serbia. He was engaged in the preparation of several transition-related laws, particularly the privatization law as well as the fiscal consolidation program known as "Avramovich's Program." His constant preoccupation is the economics of transition. His current interests include a paradigm shift in economics and the impact of Industry 4.0, AI and climate tension indices on the green transition and a circular (and regenerative) economy.

Aleksandar Kovačević

is an energy economist and the author of energy poverty analyses (UNDP, 2004) and South East Europe gas market analyses with the Oxford Institute for Energy Studies. He is also the co-author of the Western Balkans energy policy survey (IEA/UNDP, 2008), as well as World Bank analyses (2003, 2010) and has published numerous papers and lectures. With over 30 years of experience, he provides strategic advice, due diligence, policy innovation, complex energy solutions, and emergency assistance to major institutional, financial, and private clients, including coordinating the rapid reconstruction of Serbia's energy infrastructure for UN OCHA after the 1999 war. He is the Chairman of the annual Western Balkans Energy Finance Conference, a former member of the Advisory Board for the Russian Power Conference (2002-2014), and a contributor to the Oil and Gas Economy and Law (OGEL) network. He won the Innovation Award at the Power Gen Europe Conference in 2002.