



Energy Opportunity: A Solutions-Centric Framework to Catalyze Energy for Well-Being, Social Progress, and Development

By **Dr. Vivek Shastry**, **Andrew Kamau**, **Qëndresa Krasniqi**, and **Dr. Diana Hernández**

Energy enables almost everything we do—we need it to cool our homes, cook our food, drive our cars and buses, and power our schools, industries, and hospitals. It is also critical for earning a living and living well. In essence, energy enables opportunity, and the lack of it impedes individuals, communities, and countries from harnessing their fullest potential. This commentary, part of the Energy Opportunity Lab program at the Center on Global Energy Policy at Columbia University SIPA, contextualizes the scale of persistent energy burdens in both emerging and developed economies, and introduces “energy opportunity” as a solutions-centric framework for research and practice that propels change.

Energy Issues in Emerging Economies

Energy poverty, which involves issues of access, adequacy, reliability, and affordability,¹ is a pervasive global problem, but one that features most prominently in emerging economies. Whereas over 760 million people across the globe lacked access to electricity in 2022, four out of five of those individuals resided in sub-Saharan Africa.² Even as the number of people without access to electricity has declined from 1.1 billion globally in 2010, representing considerable progress, the pace of change has not been rapid enough, especially in a region like Africa. The International Energy Agency (IEA) projects that, under current policies, 660 million people will still be without electricity access in 2030, with 85 percent of them living in sub-Saharan Africa.³ Moreover, many households in emerging economies previously categorized as having access to modern energy services actually

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had only limited, unreliable, and costly access, which is inadequate to support a decent standard of living.⁴ Over 3 billion people around the globe are estimated to have unreliable electricity services.⁵ Access to clean cooking technologies lags even further behind, with an estimated 2.3 billion people globally relying on traditional biomass fuels for cooking, a practice that claims millions of lives each year due to indoor air pollution.⁶

Energy access is a necessary condition for economic development. Scholars and practitioners have challenged the notion that providing a lifeline level of electricity to households, to power a few lights and charge a phone, automatically improves development outcomes.⁷ Energy plays a critical role in enabling productive uses. Without electricity, hospitals cannot deliver basic healthcare,⁸ schools cannot utilize modern teaching tools, farmers cannot mechanize their operations, food gets wasted due to lack of cooling, and businesses struggle to keep their equipment running.⁹ Recognizing this reality, households and industries in emerging economies are demanding more and better quality electricity,¹⁰ while governments along with philanthropic and private-sector organizations are focusing on catalyzing the myriad opportunities that energy can enable to promote the fulfillment of healthy and productive lives.

Among the biggest bottlenecks for scaling up energy for development is lack of financing. This is particularly true for African countries, which, in addition to energy poverty, face disproportionate impacts of climate change.¹¹ African countries account for nearly 18 percent of the world's population but attract only 3 percent of global energy investment.¹² Due to perceived and actual risks, the cost of capital to finance clean energy projects in Africa is often at least two to three times that in developed economies, making clean energy prohibitively expensive for end users.¹³ Against the backdrop of persistent underinvestment and difficulties in accessing multilateral debt, African leaders are exploring local sources of financing, such as public-private partnerships (PPPs) and sovereign bonds, as well as the prospect of redirecting current investments in expensive high-emission electricity sources to financially and environmentally sustainable alternatives.¹⁴ For example, African countries are estimated to be spending over US \$20 billion annually to operate around 125 gigawatts (GW) of fossil fuel backup generators.¹⁵ On a levelized cost basis, running diesel generators can be up to seven times more expensive than running captive solar PV plants.¹⁶ In addition to having a higher carbon footprint, the persistent use of generators results in high manufacturing and food processing costs, which get passed on to poor consumers and leads to a higher cost of living.¹⁷ Replacing fossil fuel backup generators with renewable energy sources is one example of how local sources of capital can be redeployed to achieve the twin goals of reducing both poverty and harmful emissions.



Energy Issues in Developed Economies

Energy poverty is not unique to emerging economies.¹⁸ In applying the term to developed economies, researchers of energy poverty have expanded the definition to include the specific issues impacting the populations under study.¹⁹ A relatively well-established literature exists on energy poverty in the UK, for instance, which in its most narrow form has focused on “fuel poverty”—the inability of households to afford sufficient energy to heat their homes.²⁰ Scholars working on the United States have likewise used the term,²¹ though the related concepts of energy burden and energy insecurity are far more common in US academic and policy arenas.

Energy insecurity manifests in the form of economic hardships, physical deficiencies, and coping strategies.²² In 2020, 33.5 million US households experienced some form of energy insecurity, defined as a household’s inability to meet its energy needs adequately.²³ Over two-thirds of these households reduced their food or medicine expenditures to pay for energy costs, over one-third received disconnection notices due to their inability to pay the utility bills, and over one-third left their homes at unhealthy temperatures.²⁴ These burdens are disproportionately shouldered by low-income households and those belonging to racial or ethnic minorities.²⁵ Although government home energy assistance programs exist in the US, many households face administrative barriers to accessing them.²⁶ Thus, the Low-Income Home Energy Assistance Program (LIHEAP) had one of the lowest participation rates of any federal social safety net program in 2018, with coverage reaching only 20 percent of the 72.2 million individuals who were eligible.²⁷

Some energy burdens can be traced back to structural issues related to energy utility practices and policies. These burdens may be compounded by the way utilities design rates. For example, increasing fixed charges on utility bills has been found to have a regressive effect on low-income customers, who may consume less electricity to begin with.²⁸ In an attempt to reduce utility costs and limit financial stress, many energy-insecure households engage in energy-limiting behaviors.²⁹ The risk of disconnection due to non-payment of energy bills propels those facing this acute burden to lean more deeply into coping strategies.³⁰ Another dimension of utility practices that is receiving increased attention in the aftermath of recent storms is disparities in power outage management and restoration. Recent research based on data from managed outages during Hurricane Isaac (2018), Winter Storm Uri (2021), and Hurricane Ida (2021) showed income- and race-based inequities in power restoration.³¹ Power outages can have severe health consequences, such as carbon-monoxide poisoning (from poor ventilation of fumes from stoves, heaters, vehicles, etc.) and exacerbation of COPD and gastrointestinal illnesses (from poorly refrigerated food), particularly for individuals relying on electricity-dependent medical equipment.³²



Home energy deficiencies such as poor insulation and inefficient appliances also induce physical and psychological hardships, with households unable to maintain comfortable temperatures and sometimes being exposed to extreme temperatures.³³ Energy-insecure households thus experience higher rates of poor sleep quality and mental disorders.³⁴ Moreover, through its link to housing insecurity, energy insecurity disrupts work, school, and day care arrangements as well as social networks.³⁵ Promoting warmth and energy efficiency in the home are among the most effective housing and socio-economic determinants of interventions for improving health outcomes.³⁶

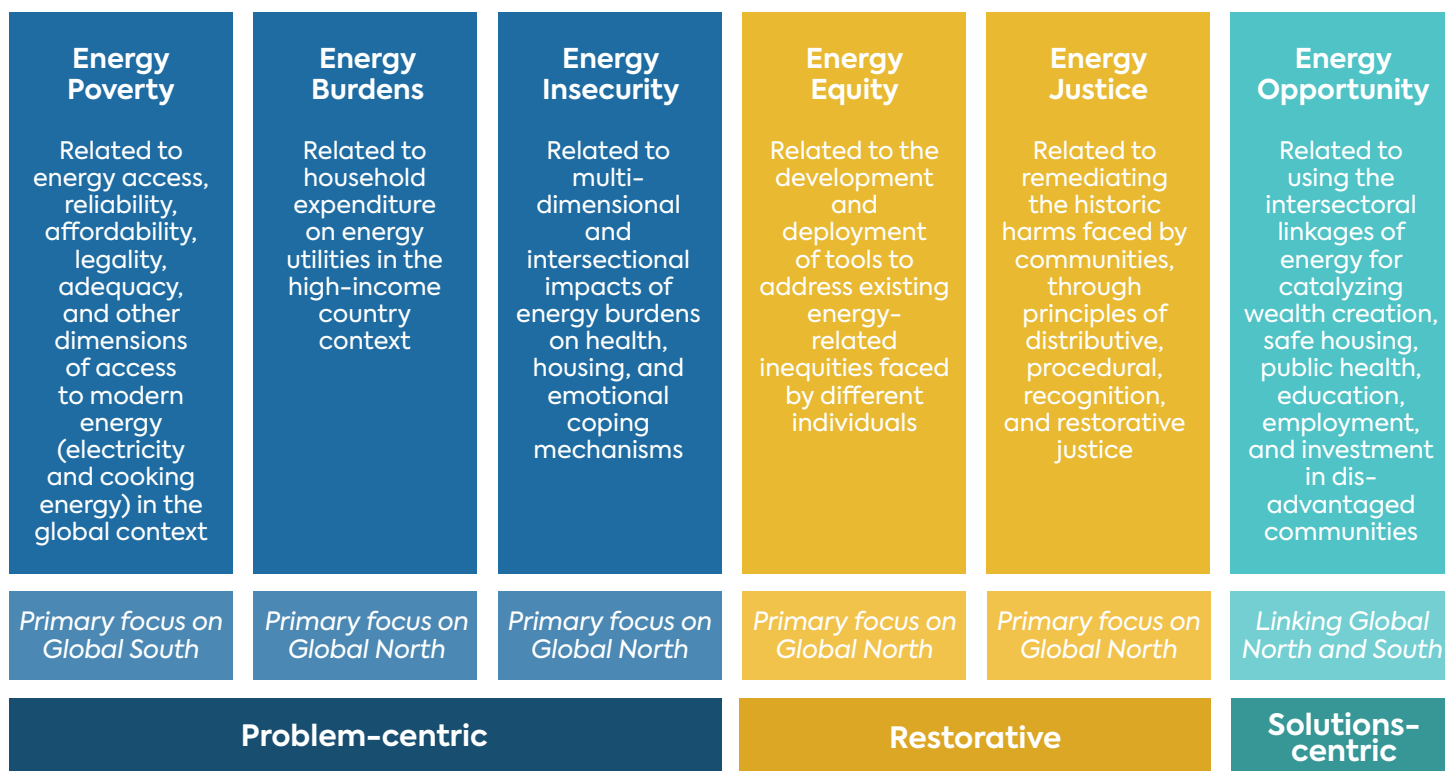
From Energy Problems to Energy Solutions

The previous two sections indicate the extent to which researchers have documented energy poverty, burdens, and insecurities, both in emerging economies and in developed economies such as the United States. This **problem-centric** literature has focused on the critical task of analyzing the multidimensional and intersectional nature of these issues, their causes, and their impacts on lives and livelihoods. Building on this work, energy equity and energy justice researchers and practitioners have developed tools, frameworks, and policies to recognize and/or reverse these historic injustices across the *energy continuum*³⁷—from planning and production to access and utilization. Energy justice research, for example, focuses on how policy tools and regulatory practices can be used to help communities that have been harmed by the energy system in the past and address the unequal distribution of ills attributable to the production or consumption of energy today.³⁸ These efforts have swung the pendulum of energy research and practice from problem-centric dimensions to **restorative** dimensions. In devising and trying to enact solutions, energy equity and justice scholars and practitioners will, of course, need to grapple with the same challenge of balancing the energy trilemma (energy security, equity, and sustainability)³⁹ that has proven so challenging to the environmental and climate justice movements out of which they emerged⁴⁰—a topic the authors intend to explore in future work.

The concept of energy opportunity is an extension of this pendulum swing from a restorative to a solutions-centric approach that frames sustainable energy as a catalyst for well-being, peace, and prosperity (Figure 1).



Figure 1: Situating energy opportunity in the problem-solution continuum



Source: Authors’ analysis of literature on selected topics.

In this sense, it is closely related to “capabilities” approaches emerging in the energy justice literature, which focus on “facilitating the realization of individuals’ diverse potentials and abilities to participate more productively in social, economic, and political life.”⁴¹

The energy opportunity concept offers several important advances. First, by fostering collaborative research involving practitioners and frontline communities, it can not only further evidence-based practices but also generate often-overlooked, practice-based evidence,⁴² bridging the gap between *what we know and what we do*.⁴³ Second, it brings research on energy poverty, burdens, and insecurity in emerging and developed economies under one purview—two research strands that hitherto rarely been in conversation.⁴⁴ Although the nature of these energy issues may be different, those who face them are united by the vulnerabilities they face, stemming from the historical legacies of structural discrimination and often exacerbated by climate stresses.⁴⁵ Third, it provides a platform for sharing best practices regardless of where they originate, including and especially those stemming from the innovations, scholarship, and practice-based leadership of

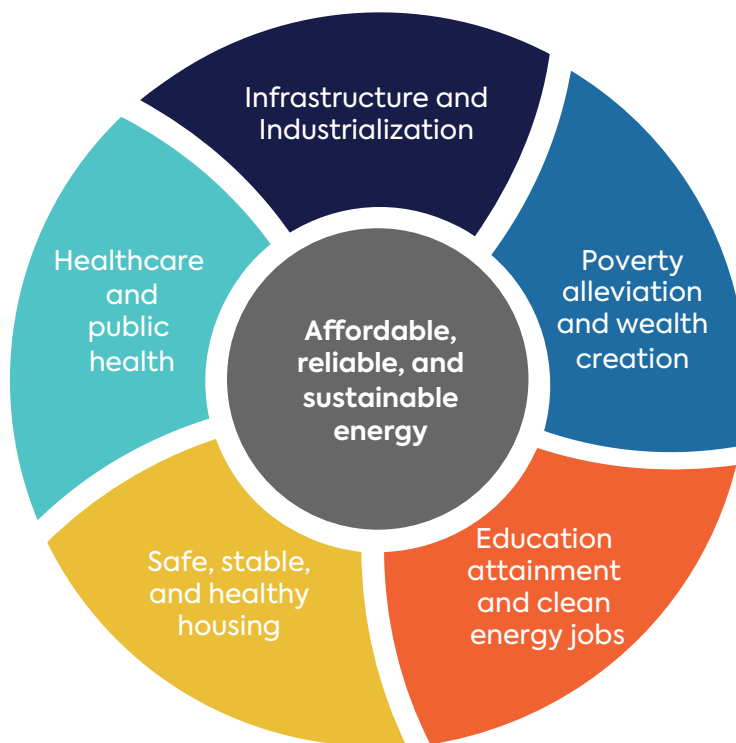


members of impacted communities.⁴⁶ This means not only that a farmer in rural Nigeria can aspire to the same energy opportunities as a farmer in New York, but also that New York can potentially learn from and adapt innovations in Nigeria. Finally, by situating solutions closest to those with lived experience of the problems, the energy opportunity framework can evolve as a bottom-up strategy.

Translating Research into Policy and Practice

The roots of the energy opportunity concept can also be found in international nongovernmental practice. Increasingly, NGO practitioners have sought to devise interventions to promote UN Sustainable Development Goal (SDG) 7—sustainable energy for all—in ways that encourage the achievement of other UN SDGs (e.g., universal healthcare, education, gender equality, and poverty eradication).⁴⁷ This holistic approach is central to energy opportunity research, which can focus on the catalytic role of affordable, reliable, and sustainable energy in promoting sustainable development, well-being, and social progress, as shown in Figure 2.

Figure 2: The energy opportunity framework: energy as a catalyst for sustainable development, well-being, and social progress



Source: Authors' conceptualization based on the interlinkages of UN SDG7 (energy) with other SDGs.



The terminological shift that “energy opportunity” makes is critically important because the language we use determines how problems are defined, solutions are developed, and decision makers are mobilized to take action.⁴⁸ Meanwhile, the shift in perspective that it promotes reveals significant research gaps that need to be filled, including the topic of energy burdens in lower-income countries in sub-Saharan Africa, which are greater than in any other region in the world.⁴⁹

Energy can enable well-being and sustainable development opportunities in both developed and emerging economies. In developed economies, spending less on energy relative to other basic necessities can allow individuals to maintain healthy indoor temperatures, meet critical medical needs during prolonged power outages, weatherize their homes, and enjoy the benefits of energy efficiency and clean energy technologies. In emerging economies, individuals can improve their health by reducing the physical intensity of their labor and the use of polluting fuels in daily life. By engaging in productive businesses and public services powered by reliable energy, individuals also stand to develop their social and human capitals through enhanced household income, business skills, financial literacy, and community connections.⁵⁰ Businesses in emerging economies can save money on expensive generators, stabilize their operations, develop new clean energy products to a vast underserved market, gain competitive advantage, expand their offerings, and generate more employment. Nurturing local economies can create employment opportunities and social security for individuals who might otherwise consider migrating in search of such opportunities. Governments in emerging economies can strengthen healthcare and education infrastructure, save billions of foreign exchange dollars otherwise spent on imported fuel and generators, set up new supply chains, target energy investments to create wealth in vulnerable communities, and improve the resilience of their infrastructure to the increasing ravages of climate change.

Conclusion

Practitioners, governments, and civil society have been highlighting the urgent need to accelerate the use of reliable, affordable, and clean energy as a means of sustainable development and social progress. Decades of research documenting energy poverty, burdens, and insecurity, and of practical action on energy equity and justice, has laid the groundwork for conceiving an ambitious and solutions-centric research agenda on energy opportunity. However, for energy opportunity to become a fully transformative construct, the concept must be widely adopted and deliberately developed as the basis of a field of study and practice. Researchers can advance this agenda by continuing to engage in cross-disciplinary collaborations, centering the perspectives of frontline communities, and emphasizing solutions-oriented approaches that bridge research with policy and practice.⁵¹ Timely dissemination of findings through accessible mediums, coupled with a commitment to ethics and integrity, will be essential in ensuring that the pursuit of this research



paradigm aligns with and extends principles of equity and justice,⁵² ultimately facilitating positive impacts in the form of development, well-being, and social progress.

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About the Authors

Dr. Vivek Shastry is a Senior Research Associate at the Center on Global Energy Policy, Columbia SIPA. His work focuses on issues of energy access, opportunity, and justice across India, Africa, and the U.S., supporting CGEP’s Energy Opportunity Lab and the India Program. He has published several peer-reviewed articles in diverse journals, contributing to the literature on global energy poverty, U.S. energy transition, and energy use in the built environment. In addition to interdisciplinary research, he brings many years of strategic planning, partnership building, and program implementation experience through his prior work with SELCO Foundation.

Dr. Shastry earned a PhD in Public Policy from the University of Texas at Austin, where his doctoral research focused on understanding the consequences of poor electricity at rural health facilities, and the impacts of adopting productive uses of renewable energy among rural entrepreneurs. He also holds master’s degrees in Sustainable Design, and Community and Regional Planning from the University of Texas at Austin, and a bachelor’s degree in Civil Engineering from National Institute of Technology Karnataka, India.

Andrew Kamau is serves as Co-Director for the Energy Opportunity Lab, leading the lab’s projects outside of the United States. Andrew was the Principal Secretary for Petroleum and Mining in the Ministry of Petroleum and Mining, charged with technical undertaking on behalf of the Government of Kenya in the areas of Oil, Gas, and Mining. He has a wealth of experience in the energy sector having worked in energy trading, oil and gas operations, and the mining sector for over 30 years. Believing



in steadfast leadership to deliver complex projects, Andrew has spearheaded several Government initiatives that have benefitted Kenyans. His vantage has allowed him insight on how to structure, negotiate, and navigate interventions that have lasting and positive impact. Among his greatest accomplishments in this regard, Andrew championed the rapid uptake of Liquid Petroleum Gas (LPG) as a primary cooking fuel and moving the per capita consumption from 3kg to 7.5kg in eight (8) years. This initiative contributed to reduction of households reliant on charcoal and firewood as a cooking fuel and reduced serious indoor pollution incidence among vulnerable women and children.

Andrew advocated for initiatives to shift the transportation of most refined petroleum products from road to rail and lake barges, thereby reducing costs and the carbon footprint. He oversaw the construction of a new rail siding, connecting the Kenya Pipeline Storage to the Port of Kisumu, allowing for the transportation of refined petroleum products by rail barges from Kenya to Port Bell in Uganda. Relatedly, he led the team working on the rehabilitation of the long defunct Nairobi-Nanyuki rail line, allowing for fuel, agricultural goods, and passengers to be transported after nearly 30 years' absence.

In the mining sector, Andrew has championed transparency through implementation of data and technology driven solutions, with a focus on identifying and leveraging minerals that will be critical for the energy transition and for which the 4th Industrial revolution is reliant. From finalization of the cadaster system that forms the bedrock for transparency in licensing, to the acquisition of geological data, Andrew has provided leadership to ensure that the country is well-positioned to capitalized on its natural resource's wealth.

Prior to his role in Government, Andrew assisted governments to conclude complex trading transactions in energy by structuring practical solutions that took into account local context and financial constraints. For instance, in the power sector in Democratic Republic of Congo (DRC), Andrew successfully negotiated a contract to rehabilitate two (2) turbine groups at the Inga Hydroelectric Dam on the Congo River thereby paving way for commercial mining activity that benefitted both the Government and its private sector partner. His intuitive insight into the most critical inputs for successful ventures in the oil and gas sector allowed him to assist the DRC government with supply of over USD 60 Mn of refined petroleum products using insurance instruments issued by the Government of South Africa and backed by oil revenue from companies producing oil in the DRC. He also crafted interventions for supply of crude oil to the Ndola oil refinery in Zambia and refined products worth over USD 200 Mn to the TEMA oil refinery in Ghana with structures that did not require both Governments to issue payment instruments.

Through his life's work, Andrew has applied himself to the energy sector's challenges and opportunities on the Continent, noting that the resilience of developing economies in Sub Saharan



Africa will depend on new thinking. He has participated as a thought leader on the energy transition conversation including encouraging approaches that balance the requirements of industrialization and climate change adaptation. He remains passionate about offering refreshing and non-traditional perspectives on the energy sector's contribution to sustainable economic development.

Beyond contributions as a public servant and international energy sector specialist, Andrew has a passion for philanthropy and has served as chairman of the Komati Foundation, a non-profit organization in South Africa, working specifically with students and young professionals to nurture leadership skills and service ethics. For his public service to Kenya, Andrew was awarded the First Class, Order Chief of the Burning Spear (CBS) in 2016. In 2005, Global Pacific Partners awarded him the Africa Oil & Gas Deal Maker of the Year.

Qëndresa Krasniqi is a Research Associate conducting analysis focusing on the role of long-term energy inequity on social vulnerabilities and disaster resilience. She will support research activities related to energy justice and equity pertaining to energy transition and resilience building. Her experience also includes analysis of the racial and income inequities as well as the public health impacts of power outages and energy insecurity.

Qëndresa holds a Master in Public Administration in Development Practice from Columbia University's School of International and Public Affairs, and a Bachelor of Arts in Financial Economics from Methodist University. Previously, Qëndresa has taught Economics and worked in policy analysis and mixed methods research with the IPCC, the World Food Programme (WFP) and the European Stability Initiative (ESI).

Dr. Diana Hernández, PhD, serves as the Managing Director of Domestic Programs at the Energy Opportunity Lab in the Center on Global Energy Policy in the School of International and Public Affairs. Dr. Hernández, is also a tenured Associate Professor of Sociomedical Sciences and Founding Principal Investigator of the Energy Equity, Housing and Health Program at Columbia University's Mailman School of Public Health. A sociologist by training, Dr. Hernández' work examines the social and environmental determinants of health including the impacts of policy and place-based interventions on the health and well-being of socioeconomically disadvantaged populations. Her foundational research on energy insecurity- defined as the inability to adequately meet household energy needs- has explored the multiple dimensions of this phenomenon identifying sociodemographic disparities, adverse consequences and promising interventions toward energy equity and justice. Much of her community-oriented research has been done in collaboration with community groups and government agencies around the country, including in the South Bronx, where she has led small-scale housing redevelopment projects. In 2022, Dr. Hernández spearheaded the establishment of a collaboration between the Energy Bar Association, the Sabin Center for



Climate Law, CGEP and Mailman to explore energy insecurity from a legal, policy and regulatory perspective. Dr. Hernández' research has been funded by the National Institutes of Health, the Robert Wood Johnson, JPB and Alfred P. Sloan Foundations, and the Department of Housing and Urban Development, among others. Professor Hernández teaches graduate level courses on qualitative research methods, design and analysis; public health leadership; and energy justice. She holds several leadership positions including as the Deputy Director of the NIEHS Center for Environmental Health and Justice in Northern Manhattan; she is also a Mayoral Appointee on NYC's Environmental Justice Advisory Board. Professor Hernández has written for and been featured in various media outlets including the NY Times, USA Today, BBC, NY Daily News and CityLab. Her debut book about energy insecurity in the US is due to be published in 2024.

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