

## A wake-up call on India's energy vulnerability

THE war in Iran may not be a world war, but its impact is being felt across the globe.

Just two weeks into the conflict, ripple effects are already visible in trade routes, travel patterns, energy prices, geopolitical alignments and everyday living costs. Far from the battlefield, residents in Kolkata are queuing for gas, tourists are leaving Cyprus, and farmers across the Northern Hemisphere are growing anxious about the upcoming spring planting season.

The crisis is also reshaping geopolitics. For Russia, it appears to be an opportunity, while for China, the implications are less favourable—at least for now.

Back home in India, the effects are beginning to reach household kitchens. Supply constraints have tightened deliveries of liquefied petroleum gas (LPG), forcing many households and food businesses to rethink how they cook.

In several areas, hot meals and even tea are being replaced with simpler options such as fast food or lemon water as people try to stretch limited fuel supplies.

With cooking gas prices rising and concerns over supply disruptions mounting, households are increasingly looking for reliable alternatives. While LPG remains the primary cooking fuel in most urban homes, a number of practical options can help keep kitchens running during shortages.

Government data shows that LPG consumption in India has grown steadily as families move away from traditional fuels like firewood and coal. Initiatives promoting cleaner cooking fuels have expanded access nationwide. However, this also means that even temporary supply disruptions can quickly affect daily routines in both homes and small food businesses.

Among the most viable alternatives is the induction cooktop. These appliances use electricity to heat

cookware directly and can handle a range of cooking tasks, from boiling to frying. For households with stable electricity, induction cooking offers a dependable backup.

Electric rice cookers and pressure cookers can efficiently prepare staples such as rice, lentils, soups and steamed vegetables without LPG. Many households already use these appliances, making them a practical substitute during shortages.

Electric kettles, though primarily used for boiling water, can also be used to prepare instant noodles, soups, boiled eggs and beverages, helping reduce dependence on LPG for basic needs.

Microwave ovens can further ease the burden by reheating leftovers and preparing quick meals. Ready-to-eat and frozen foods can be managed easily, offering short-term relief from gas dependency.

Meanwhile, the Strait of Hormuz remains at the centre of global hydrocarbon trade. In 2024, nearly 20 million barrels of oil per day passed through this corridor, about 20 percent of global petroleum consumption, making it one of the world's most critical energy

chokepoints. LPG traffic through the route has been severely disrupted due to the ongoing crisis, with cargo movements slowing and importers scrambling for alternatives. For a country like India, where a significant portion of LPG supply depends on seaborne imports, this global disruption has quickly translated into a domestic allocation challenge.

There is, however, some relief in sight. India is expected to receive two LPG cargoes totalling 80,000 tonnes via the Strait of Hormuz in the coming days.

Industry bodies such as the National Restaurant Association of India have urged authorities to prioritise restoration of supply to ensure uninterrupted fuel access, particularly for food businesses.



# Beyond bombs: The hidden health fallout of Iran war

Airborne toxins from strikes threaten lungs, hearts and long-term public health

ARMIN SOROOSHIAN

THE waves of US and Israeli bomb strikes in Tehran and Beirut, and Iran's missile and drone attacks on neighbouring countries in response, are damaging more than buildings they are sending toxic debris into the air in cities that are home to millions of people. Military strikes have hit Iran's missile stockpiles, nuclear facilities and oil refineries. When a strike set fire to an oil depot, it sent toxic black clouds billowing over Tehran and created oily rain that settled on buildings, cars and people. Residents described having headaches and difficulty breathing. As a chemical and environmental engineer who studies the behaviour and effects of airborne particles, I have been following the damage reports to understand the health risks residents are facing as toxic materials get into the air. The risks come from many sources, from heavy metals in the munitions themselves to the materials sent airborne by what they blow apart.

### The invisible enemy during war: Air pollution

A disaster's effects on air quality and public health depend in large part on what is being destroyed. The terrorist attacks on New York City's World Trade Centre on Sept. 11, 2001, were localised, but they ejected massive bursts of pollutants into the air. These included gases such as volatile organic compounds and particulates often called aerosols containing a myriad of substances, such as dust, polycyclic aromatic hydrocarbons, metals, asbestos and polychlorinated biphenyls. These pollutants can harm the lungs, making breathing difficult, and worsen cardiovascular problems, contributing to heart attacks, among other health damage.

Tiny particles smaller than 2.5 micrometres, called PM2.5, are especially harmful because they can travel deep into the human respiratory system. But larger particles can also bring major airborne health risks. When buildings are heavily damaged or collapse, the rubble often contains crushed concrete, gypsum and carcinogenic fibrous materials, such as asbestos. Even after the initial dust settles, wind and other disturbances, including efforts to find survivors or clear the rubble, can send those materials back into the air, putting more people at risk. Many rescue and recovery workers who responded to the World Trade Centre collapse in 2001 developed chronic respiratory problems. That's also a risk for people searching for survivors in bombed buildings after military strikes and later when cleaning up the debris. Fires create additional hazards as vehicles, buildings and the chemicals and other materials in them burn. The January 2025 fires in Los Angeles sent a stew of dangerous particles and gases into the lower atmosphere. Studies have shown how lead particles that fell to the ground were kicked back up into the air again, where people could inhale them, along with other contaminants.

### Munitions and oil facilities

Military attacks degrade air quality in other ways. The Gaza Strip, Iraq, Kuwait, Ukraine and most recently Iran and surrounding countries have all faced extensive damage from munitions, which contain toxic materials. Bombs and artillery often contain explosives and heavy metals, such as lead and mercury, which also contaminate soil, water and the environment. When oil storage facilities and pipelines are damaged, they emit



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an especially harmful cocktail of pollutants. This chemical blend includes airborne soot particles, which darken the sky and contribute to the "black rain" observed in Iran. During the Gulf War in 1991, downwind countries experienced similar polluted rain as Kuwait's oil fields burned. The US Department of Defence found that the smoke plumes contained sulfur dioxide and nitrogen oxides, among other gases and soot. The severe consequences of environmental pollution during wars prompted the US National Academies of Science, Engineering, and Medicine to publish a series of reports on Gulf War military veterans' health, starting in the early 2000s. They documented illnesses soldiers suf-

fered after being exposed to chemicals and heavy metals, including from oil well fires. They also examined scientific evidence on potential associations between pollution in war and reproductive and developmental effects in the veterans' children.

### Getting pollution out of the air

Nature, including rain and wind, can help reduce the pollution levels in the air. Rain helps pull particles out of the air, depositing them back on the ground and surfaces. The raindrops form around particles and also collect more particles as they fall. However, rain has occurred only sporadically since the military attacks began in Iran. And rain

also contributes to runoff into streams, and pollutants can damage crops and contaminate waterways, soil and vegetation. Wind can help blow pollutants out of an area, though at the expense of downwind sites. Tehran has another challenge when it comes to pollution because of its terrain. The city is surrounded by mountains and prone to the effects of low-altitude temperature inversions in the wintertime, which concentrate pollutants even more by holding them closer to the ground. These attacks have been slightly outside the coldest periods for Tehran, allowing for deeper mixing of air, but the inversion still has an effect.

### Can people in war zones protect their health?

People in war zones, where they are already under stress, can reduce their health risks by staying indoors in the days after military attacks, if possible. Keeping windows and doors closed can help reduce the amount of polluted ambient air that comes inside. Indoor air quality is just as important as the air outside. For example, infants crawling on floors can be exposed to deposited particles with toxic materials that are tracked in or blown in under sills and doors, similar to wildfire smoke exposure. As buildings continue to smoulder and clearing debris sends harmful particles back into the air, the pollutants can also contaminate agriculture and waterways. People can try to avoid crops, water and seafood that were likely to have been affected by toxic airborne pollutants. However, getting information about risks gets harder in a time of war, and scarcity can leave people with few choices.

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## From Goddard to moonshots: 100 years of rocket revolution

A century after Robert H. Goddard's first launch, spaceflight evolves from fragile experiments to private-sector dominance

MICHAEL CARRAFIELLO

APOLLO 11 first landed astronauts on the Moon in 1969, but the journey to the lunar surface actually began 43 years before, in snowy Massachusetts. Exactly 100 years ago, on March 16, 1926, Robert H. Goddard launched the first liquid-fueled rocket. Liquid-fueled rockets would eventually provide the power to send humans to the Moon. Still, Goddard's vehicle was small, flew for only 42 seconds, reached a height of a mere 184 feet and sustained damage that created more doubters than believers in the prospects for human space flight. Despite this less-than-spectacular start to the space age, Goddard's rocket was the beginning of a century of innovation. Today, hundreds of rockets launch each year. Giant liquid-fueled rockets combine liquid oxidiser a substance that releases oxygen and liquid fuel.

These create chemical reactions that produce the explosive thrust necessary to propel humans to the Moon. As a historian, I've spent 40 years studying the winding path that led to the development of modern rocketry. I've also seen how, over the past few years, private companies have played a much larger role in spaceflight than they did throughout most of its history.

### Early days of spaceflight

After Goddard's first liquid-fueled rocket launch, the development of American rocketry crept along at a snail's pace until World War II. Nazi Germany's invention of the V-2 missile proved that rockets could provide immense strategic and scientific value during both war and peace. In war, the V-2 terrorised Britain and its allies. In peace, scientists looked at launching artificial satellites, or "moons" as they were originally called, to survey weather and boost intercontinental communication. The United States government did not invest heavily in rocketry throughout most of the 1950s. Then, on Oct. 4, 1957, the Soviet Union shocked the world



Robert Goddard, considered the father of modern rocketry, standing with a rocket in 1935

by launching the world's first artificial satellite, Sputnik I. Millions of Americans feared that the USSR would soon rain nuclear missiles on them. President Dwight D. Eisenhower and his advisers, however, displayed little anxiety at this prospect. They believed that America's problems on Earth were more urgent than those that might emanate from space. Political pressure from the Senate majority leader, Lyndon B. Johnson, caused Eisenhower to reconsider. Late in 1958, the Republican president gave his consent for Congress's establishment of the National Aeronautics and Space Administration. This new agency then went about selecting America's first seven astronauts, introducing them to the nation in 1959.

### Americans to the Moon

The arrival of a new, young chief executive, John F. Kennedy, sharpened the United States' commitment to space. In September 1962, the president publicly challenged the nation to land an astronaut on the Moon before 1970. To Kennedy, the enormity of such a scientific and public achievement would provide unimpeachable proof to the world that the American way was superior to life behind the Iron Curtain. JFK's untimely death in the autumn of 1963 only served to strengthen the nation's commitment to the late president's lofty goal. A mere five-and-a-half years later, astronauts Neil Armstrong and Buzz Aldrin walked on the lunar surface during the Apollo 11 mission. To get them there, NASA had spent nearly USD 26 billion, or USD 338 billion today. They had employed hundreds of

scientists and engineers and hired thousands of workers from dozens of contractors. Yet, at almost the very moment the supreme triumph of Apollo 11 unfolded, public support for the manned space program evaporated. Preoccupation with the Vietnam War, economic inflation and nagging social and political inequality, as well as boredom with moonshots, led most Americans to turn away from the cosmos. Richard Nixon, who followed Johnson into the Oval Office, slashed NASA's budget. Three of the remaining lunar missions were abruptly and unceremoniously cancelled. NASA had to abandon spectacular yet wasteful rockets like the Saturn V in favour of cheaper and more versatile launch vehicles.

### Enter the Space Shuttle

Unlike earlier rockets, the next generation of rockets had to become almost completely reusable. The result: development of the Space Shuttle. NASA promised that the shuttle would launch no later than 1977 and that, when fully operational, it would rocket into orbit every two weeks. That vision never materialised. By the time the first shuttle finally took off in 1981, it was grossly over budget. Problems with the heat tiles necessary for reentry persisted. Ultimately, the shuttles never came close to launching biweekly. Instead, only six to eight missions per year proved feasible. Worst of all, the program would eventually sustain two heartbreaking tragedies. In 1986, the space shuttle Challenger exploded 73 seconds after takeoff. In 2003, Columbia the first shuttle to ever reach space disintegrated

as it reentered the atmosphere over Texas. The following year, President George W. Bush announced that the remaining shuttle fleet would retire no later than 2011. NASA's air of invincibility and inexhaustible stream of funding had long vanished. The final shuttle flight served as a coda to the heady days of the 1960s and '70s. Subsequent presidents talked of missions to Mars and created a Space Force, but the old Apollo launchpads at Cape Canaveral were abandoned, or "mothballed," as NASA termed it. Thousands of workers were laid off. Leadership in space passed to private corporations like Elon Musk's SpaceX and Jeff Bezos' Blue Origin.

### Enter private companies

As early as 2006, NASA began contracting with SpaceX to launch its payloads and astronauts to the International Space Station. By 2024, SpaceX had realised the unfulfilled vision of NASA, launchers on a nearly biweekly basis. Meanwhile, while NASA's Artemis program plans to send a crewed mission around the Moon using a launch system developed by the agency, the program remains years behind schedule. To date, it has cost at least three times more than originally budgeted. Across the Pacific, China has announced that it will place astronauts on the Moon by 2030, with missions to Mars planned after that. For America's rival on the world stage, government, industry and science all move in concert. Compared with China, the United States' future in space appears far less unified, coordinated and purposeful. A dynamic president once galvanised the US government and its people to produce a "giant leap for mankind." But since that July day in 1969, leadership in space has steadily passed from government to private hands, with the future of American space flight appearing murky.

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## Oil, inflation, instability: The expanding cost of war

The deeper the conflict runs, the wider its impact on growth, stability, and global cooperation

VINCENT FERNANDES

WARS are rarely necessary. They represent a failure of diplomacy and result in widespread destruction, often driven more by political or economic interests than by unavoidable human conflict. Rather than resolving root causes, wars tend to perpetuate cycles of violence. Sustainable peace lies in dialogue, cooperation, and conflict prevention.

The cascading economic fallout from the conflict in the Middle East is extending far beyond the Gulf, reshaping global markets and supply chains in ways that could last for years.

This is not merely a regional crisis. It is a structural shock to the global economy at a time of geoeconomic fragility. The longer it persists, the deeper and more lasting the damage becomes. The initial impact is felt in oil, gas, shipping, and aviation; it then spreads to inflation, industrial costs, and food security; and ultimately affects trade routes, investment decisions, and political stability.

The asymmetry at the heart of this conflict's economic geography is striking. The United States imports relatively little oil through the Strait of Hormuz, while Asian economies bear a disproportionate burden. In 2024, more than 80% of oil and LNG shipments through the Strait were destined for Asia, with China, India, Japan, and South Korea as primary consumers. Japan depends on the Middle East for about 90% of its crude oil imports, most of which transits through Hormuz. South Korea sources around 70% of its crude from the region, with over 95% routed through the same passage. LNG prices in Asia have surged, prompting South Korea to activate a 100 trillion won (approximately \$68 billion) market-stabilisation programme.

China's substantial strategic and commercial oil reserves may cushion short-term disruptions. How-



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ever, its already modest growth outlook for 2026 faces increased pressure. Rising energy costs will directly impact production in key sectors such as steel, chemicals, and electronics, squeezing margins and weakening export competitiveness amid ongoing trade tensions.

India, with more limited reserves and a heavy reliance on Middle Eastern crude, is particularly vulnerable to prolonged disruption. Elevated energy prices are fuelling inflation, weakening the rupee, and threatening growth. Wheat prices have also risen, and analysts warn that lower-income, import-dependent nations could face acute stress if the conflict continues. The war is already complicating monetary policy decisions worldwide. Economists in coun-

tries as far afield as Chile and Poland are revising expectations for interest rate cuts as oil prices rise and uncertainty deepens.

The shock is global because price transmission is uneven. Wealthier Asian economies can rely on reserves and stabilisation funds, while poorer fuel- and food-importing nations in Africa and Asia face immediate and severe consequences, higher household costs, fiscal strain, supply disruptions, and increased risks of rationing or unrest.

For economies already burdened with debt, the conflict is evolving into a balance-of-payments crisis as much as an energy shock.

The economic architecture of the conflict reveals a deeper contradiction. The United States has imposed significant costs on many of the same economies it depends on as trading and strategic partners. This strain could complicate coalition-building for post-conflict stabilisation and future global crises. When conflict disrupts one of the world's most critical trade routes, secondary and tertiary effects multiply in unpredictable ways. Insurance premiums rise, investments are delayed, supply chains are rerouted, and confidence in regional stability declines. What begins as a battlefield disruption quickly becomes a geoeconomic shock.

If oil prices remain elevated, global inflation will exceed pre-conflict forecasts while growth slows. This may seem incremental, but for import-dependent economies already under strain, the consequences are significant. Fertiliser shortages will affect agriculture, crop losses will emerge over time, and food insecurity will worsen.

If the conflict persists, governments will face mounting pressure from rising import bills, tighter monetary conditions, shrinking fiscal space, and growing domestic unrest. The true cost of war is often reflected not in headlines, but in quieter realities—under-fertilised farms, rerouted flights, scarce industrial inputs, and households struggling with rising food and fuel costs. For many economies, the margin for error is rapidly disappearing.