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Study on energy security in India: future directions and strategies

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Abstract
The word "energy security" has established itself as a famous catchphrase, not only in the scientific community but also in the political discourse. However, more generally speaking, the notions that are applied to energy security are fairly hazy. Through the lens of Indian culture, this study throws some insight on many issues related to energy security. To begin, we will have a conceptual discussion on the problem of energy security. Then, by presenting a concise overview of the many initiatives that have been made to define and, therefore, quantify energy security. We have then proposed a course of action for enhancing the energy security by doing an analysis of the numerous issues that have been raised. Our result implies that it is important to take into account the structure of the market in addition to the stability of the political system.

Keywords: sanctions, burning, a forest, land, Pontianak

Introduction
Energy is required for growth. Given that India's economy is projected to grow at a rate of more than nine percent over the next ten years, it should come as no surprise that the country has developed an insatiable hunger for energy. It has been shown beyond a reasonable doubt that there is a correlation between a nation's growth and its energy usage. In point of fact, the problem of energy security has been brought to the forefront in a significant way as a result of India's consistent economic growth. On the other hand, the idea of "security of energy supply," or sometimes known as "energy security" in its abbreviated version, seems to be very hazy. It is clear from a more in-depth examination of the present circumstances that the idea of energy security is regularly used to explain a number of different policies or actions at the same time, even if these policies seem to be in conflict with one another.
In the creation of energy security, strategies that promote alternative methods are backed by a collection of agents that are of a fairly diverse nature in and of themselves. The possibility of energy instability is used by some agents as a justification for the construction of coal-fired power plants in nations that possess domestic coal deposits, while others advocate for the construction of nuclear power stations. At the same time, the promotion of diverse renewable energy sources may be justified by the fact that there are components of energy security that serve as a reason. In spite of the fact that these plans are geared towards lessening reliance on foreign energy sources, some propose broadening and diversifying the routes through which imports are made.
Energy security has generally been linked to the protection of access to oil supplies and the anticipation of the depletion of fossil fuels in the near future. The oil crisis that occurred in the 1980s brought to light the fact that nations in the Middle East that sell oil are very dependent on such countries. As the usage of natural gas increased, there was a corresponding rise in the number of security issues around natural gas, which expanded the notion to include other fuels.
The fact that the energy security is intimately tied to other policy concerns which impact the energy system ; such as cheap energy and climate change and environmental policy ; suggests that it is vital to analyse the energy security repercussions of alternative approaches.
In this article, we want to propose a way ahead for increasing energy security by analysing the numerous challenges for India. Our goal is to provide a way forward. The material that is now accessible makes it abundantly clear that there are several points of view on the meaning of the idea. For this reason, it is essential to provide a definition of energy security before engaging in a discussion from an Indian point of view about the numerous problems. It is for this reason that we have first attempted to define the notion, and then we have discussed the worldwide situations. Because of this, we are able to create a schematic

ordering of restrictions from an Indian point of view. Consequently, the next step is laid out with relation to the focus that they place.

An Insight Into Energy Security

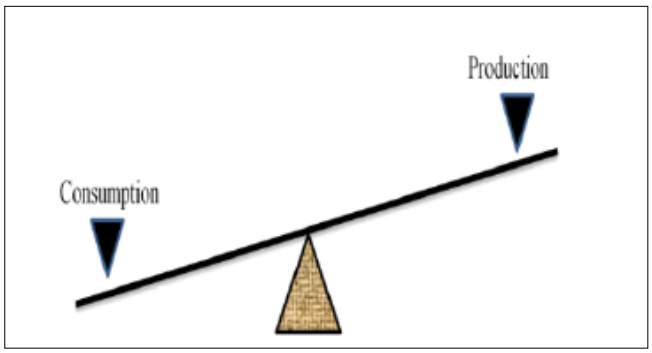

Fig 1: Visualization for Energy Security

The concept that a continuous supply of energy is essential for the operation of an economy is the conceptual foundation upon which the interest in energy security is founded. Availability of energy with needed quality of supply is not only vital to sustainable growth, but also the commercial energy has a direct effect and influence on the quality of service in the sectors of education, health and, in fact, even food security. These basic and fundamental necessities of any civilisation would certainly be affected in a very negative way if there was an insufficient supply of energy. Consequently, there is an immediate and pressing need to significantly increase the availability of energy at a quick speed in order to meet the goals of those individuals who have been shielded from such essential inputs and services so far. It has long been connected with the security of access to oil supplies and with imminent fossil fuel depletion.

Defining Energy Security

The United Nations Development Programme (UNDP) published a paper in 1999 that defined energy security as the continuous availability of energy in a variety of forms, in adequate amounts, and at costs that are affordable.

- This definition comes from an article published in the Wall Street Journal by Daniel Yergin, who described energy security as "the security and integrity of the entire supply chain and infrastructure, from production to the consumer."
- •In his capacity as President of India, Dr. A.P.J. Abdul Kalam describes it as "ensuring that our country can supply lifeline energy to all of its citizens, at affordable costs at all times." He sees energy security as based on a few principles: conservation; secure access to all sources of energy globally (even though he believes “the end of thea fossil fuel era is fast approaching”); and access to “reliable, affordable, and environmentally sustainable energy.” On the other hand, he considers energy security to be little more than a temporary step on the path to what he considers to be India's primary and most important objective, which is "energy independence," which he believes should be attainable by the year 2030.
- •The Parikh Committee report stated that a country is considered to be energy secure when it is able to supply energy to all of its citizens and meet their demand for safe and convenient energy at affordable costs at all times with a prescribed level of confidence taking into consideration shocks and disruptions that can be expected. This is the case for India.

The concept of energy security, as well as its definitions, have expanded over the course of time. The majority of studies, on the other hand, focus on policies that combat energy insecurity and mitigate the externalities of disruptions in energy supply. However, these studies do not explicitly explain the concept of energy (in-)security or how to measure the level of insecurity. On the other hand, it is difficult to provide a precise definition of energy security since the concept might mean various things to different individuals at different times and in different contexts. Attempting to define energy security seems to be considerably more difficult, if not premature, due to the fact that the concept of energy security is not explicitly defined. According to the deputy chairman of the planning commission, "it was never clear in anybody's mind what energy security is." This is a statement that has been made. In order to better understand what is meant by the term "energy security," let us examine the many references to pricing.

The Planning Commission of India has probably come closest to providing a comprehensive and official Indian definition of energy security to date: “The country is energy secure when we can supply lifeline energy to all our citizens as well as meet their effective demand for safe and convenient energy to satisfy various needs at affordable costs at all times with a prescribed confidence level considering shocks and disruptions that can be reasonably expected.”

At the same time as there has been a rise in the use of the term "energy security," there has not necessarily been an improvement in the clarity of its meaning, which covers a broad variety of interpretations.

- The assurance of a steady supply of natural gas and oil; the protection of intercontinental connections.
- Oil security—some people who belong to this party feel that energy security is more than just defending against transitory interruptions; there are some who believe that it should also take into account price volatility, which is a threat to India's economic security.
- Independence from imports, often known as "oil self-sufficiency," although the majority of specialists consider this concept to be one that is propagated by those who either have not evaluated India's circumstances in a realistic manner or have a limited understanding of the technical realities.
- Taking into consideration the needs of individuals in addition to the requirements of the nation as a whole as a whole.

Indicators for energy Security

There have been a significant number of efforts made over the course of the last several years to develop indicators for energy security. While some of them focus on a particular facet of energy security, others make an effort to include a number of other components that are pertinent into a single aggregated indication. The purpose of this study is not to try to quantify the externality; rather, we are attempting to establish ordinal metrics for various facets of what is often referred to as energy security.

Consequently, we begin with a summary of the indicators of energy security that have been discovered in the research that has been done up to this point.

Resource Estimates

As a result of the fact that the actual presence of energy sources or their availability is of the utmost importance for Energy Security, the resources that are still accessible may be used as a direct indication for Energy Security. The quantities of hydrocarbon resources and the potentials for their production are, however, surrounded by a great deal of uncertainty. Few studies have been conducted that offer estimates of the fossil resources that are available. The one that is most well-known is the one that was produced by the United States Geological Survey (USGS) (using the year 2000). "Pessimists" or proponents of the peak oil hypothesis say that the predictions provided by the United States Geological Survey (USGS) are too optimistic, despite the fact that the USGS is considered "one of the most independent and reliable sources of data." In light of this, there is no agreement over the resources that are accessible.

Reserves to production Ratios

The reserves to production ratios, which are often referred to as R/P ratios or RPRs, are frequently used as a measure of energy security. These indicators provide information on the number of years of output that are still available at the present levels of production. Due to the fact that neither reserves nor production rates are guaranteed, a combination of these two components will likewise be considered a dynamic quantity. In actuality, constant components are often used for both of these situations. While presenting the available reserves in terms of current output is generally straightforward to grasp (communicative), the indication maybe perhaps overly basic in case of quickly changing demand and/or highly uncertain reserve estimations. If, on the other hand, one utilises anticipated production levels rather than current ones (which results in what are known as dynamic RPRs), then the indication becomes less visible.

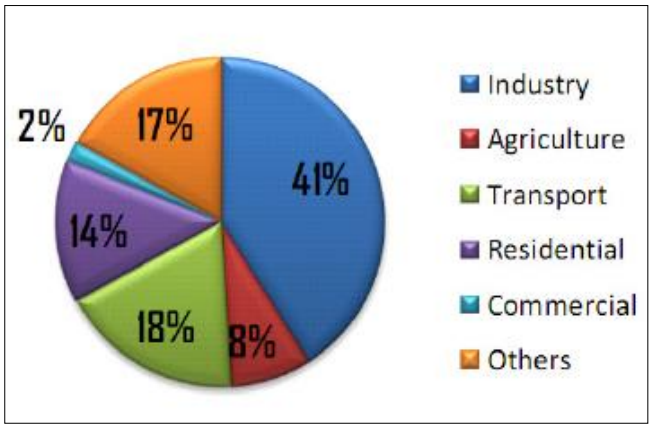

Fig 2: Sector-wise commercial usage of Energy in India. (Source: TERI Analyis)

Import Dependence

A few of the indicators that are used most often for the purpose of determining energy security include measures of import dependency. There are a number of other disaggregations that may be made with relation to fuels and geographies, and these can be stated in either monetary or physical terms. One such indication is the amount of oil that is imported, which is often stated in relation to the amount of oil that is consumed. For the aim of ensuring energy security, it would seem that the most feasible approach would be to examine nett imports. In the event of a nation or area operating as a transit hub, or simply in the setting of freely traded commodities, eliminating the exported energy (or oil/gas/electricity) offers a more realistic perspective of actual reliance. A clear and informative signal that does not need any specialised knowledge to interpret is provided by import shares. This indication is used rather often. Assuming that global energy markets operate at their full potential, one may argue that the degree of dependency on imports is less significant in terms of energy security. Because access to energy supplies is an essential component of energy security, import shares are a valuable indication in a world that is becoming increasingly regionalized. This is because trade barriers and a mindset that emphasises competition rather than cooperation are prevalent.

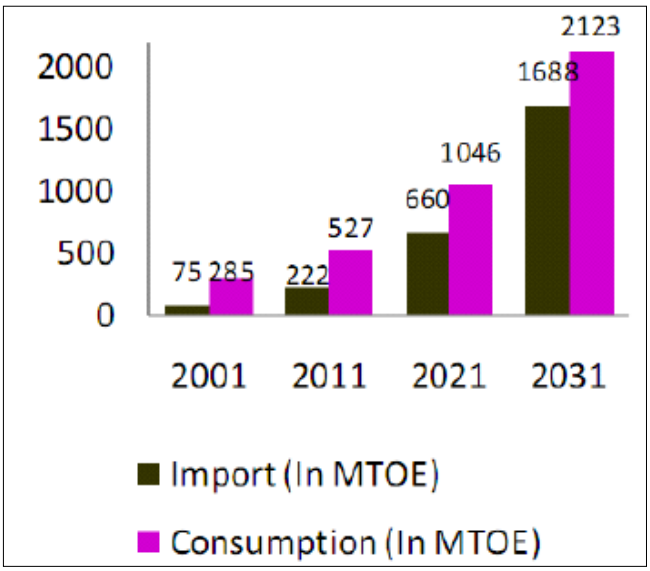

Fig 3: India's Likely Energy Dependency. (Source: TERI Analyis)

Political stability

When it comes to the public discourse on energy insecurity, it seems that the most disturbing pronouncements originate from the political arena rather than from the field of economics. A noteworthy example is the fact that the import of costly energy implies a wealth transfer to specific governments which could be conflicting with the importer's policy aims. When it comes to the issue of energy security, the economic component is of utmost significance since it is a circumstance in which one nation might pose an economic danger to another nation, namely by intentionally inflicting economic damage on the other nation. The field of economics, on the other hand, is incapable of providing a comprehensive solution to the problem. This is due to the fact that standard economics does not take into account politically motivated changes in preferences or deviations from the principle of rationality. For example, accepting one's own harm if doing so causes more harm to another person.

The Energy Price

Price serves as a mechanism that maintains equilibrium between supply and demand in a market that is healthy and working properly. As a result, prices provide an indicator of the supply in proportion to the demand, and they are also believed to be a measure of the effects that economic factors have. Furthermore, they are a manifestation of scarcity, which in turn is a reflection of the depletion of energy supplies.The price of oil is a significant factor in this.

Because oil is the most widely used energy carrier in the majority of regions throughout the globe, the price of oil is considered to be an essential indication of energy security. Using oil prices, on the other hand, presents a challenge due to the fact that these prices are also impacted by other variables (such as speculation, strategic communication, and short-term shortages).In the context of scenarios, it is important to highlight that historically, it has been incredibly difficult to precisely estimate oil prices. This is something that should be taken into consideration. In comparison to other scenarios, the use of oil prices as an indication of energy security is mostly beneficial overall.

Market liquidity

The ability of markets to deal with shifts in supply and demand is referred to as market liquidity. As a result, market liquidity is pertinent to a debate on energy security because of its nature. Market liquidity is defined as the exponential function of the ratio of a country's consumption over the entire amount of that fuel that is accessible on the market. The International Energy Agency (IEA) includes a market liquidity metric in their information paper on energy security. An further connection exists between the idea of market liquidity and the notion of price elasticity. For stock markets, it has been recommended to utilise a coefficient of elasticity of trading (CET) as a indication of market liquidity defined as the relative change in trading volume over the relative change in price. The presence of values that are less than one indicates an inelastic market, while the presence of values that are more than one indicates an elastic market.

Energy Security Disruptions

Within a world that is characterised by both fast change and uncertainty both. In order to improve the quality of life for its citizens, India must use the resources and possibilities that are at its disposal to the fullest extent possible. It is necessary for India to have a tranquil and secure atmosphere in order for it to be able to focus on the modernisation of its economy and society as well as the advancement of its technical capabilities. The desire of a nation to achieve peace and quick growth, on the other hand, is not sufficient to ascertain the nation's safety and prosperity on its own. India is a quickly expanding nation that is now confronted with the significant issue of supplying the constantly rising demand for electricity. With regard to the amount of energy that is required, India is ranked sixth in the world. It is anticipated that its economy would expand by seven to eight percent over the next twenty years, and as a result, there will be a significant rise in the need for oil to power transportation on land, sea, and in the air. India's need for energy is being driven by a number of factors, including rapid urbanisation and industrialisation, increasing earnings, and the expanded usage of items that require a significant amount of energy. At the very least in India, there has been a long-standing concern over India's energy needs. The degree of worry, on the other hand, has lately risen, as has the fact that this emotion is now being repeated in other countries, although for different reasons. As a consequence of this anxiety, there has been a clamour regarding the most effective energy and oil strategy for India, rather than a discussion. It is anticipated that by the year 2030, India would surpass both Japan and Russia to become the third biggest user of energy on a global scale. On the other hand, if consumption continues to follow the same pattern and trajectory as it has been, it is anticipated that the nation would exhaust its principal source of energy, coal, in forty years. To add insult to injury, the country's internal oil and gas supplies are very limited.

The situation is complicated by a number of factors

India's energy mix

Despite the fact that India has substantial coal reserves, the country's oil and gas resources are not quite as abundant. The country's oil reserves are estimated to be 5.9 billion barrels, which is equivalent to 0.5% of the world's total reserves. The country's total proved, probable, and potential reserves are close to 11 billion barrels. The vast bulk of India's oil reserves are found in fields that are situated onshore in Assam and offshore in the Bombay region. The domestic output of crude oil has remained stagnant, which has resulted in India importing around 70 percent of its oil, with the majority of it coming from the Middle East. Its dependency is gradually increasing in scope.

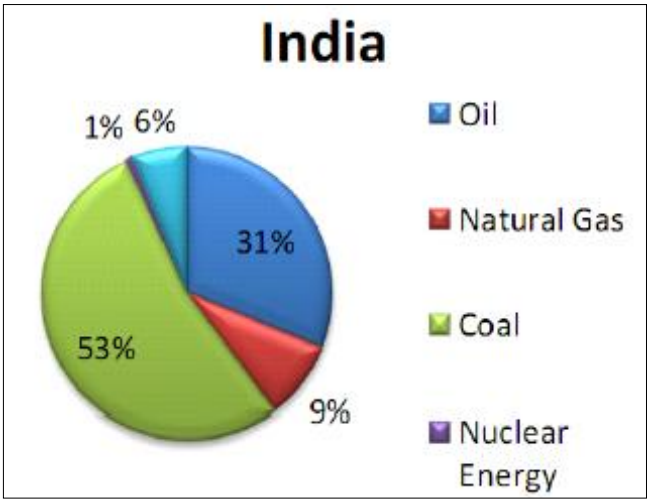

Fig 4: Energy Mix (BP Statistical Review 2009)

Dismal domestic Exploration and Production

The exploration and production capacities of India have been constrained as a result of the late technological advancements that have occurred in comparison to other established and emerging nations such as the United States of America, China, Japan, and other countries.On the other hand, ever since then, the demand for energy has been steadily growing as a result of both the expansion of existing infrastructure and the ongoing growth of the population.The proved reserves in India are still not close to meeting the demand of the nation, which resulted in a rise in the amount of fossil fuels that were imported into the country. As a result of the establishment of Reliance, the nation's capacity for production has been significantly enhanced.

Political Instability

India's politicians—no less than their American counterparts—are sensitive to the threat of being penalised at the elections for high energy costs. Therefore, "affordability" is not only a goal that would be motivated by altruism. There is usually a great lot of protest and wringing of hands before any increase in the cost of energy is accepted by a government that is now in power, even if it is obvious that the increase is necessary. It is also possible for India's national political parties to function at the state level. In the

other direction, its regional parties have been playing an increasingly important role at the national level. As a result of all of this, elections are regularly on the horizon, and as a result, there is a significant need to appeal to the people. In addition, coalition administrations, which have become the standard in India, need the prime minister who is now in office to grapple with a variety of different perspectives on energy policy. The electoral majorities in India have been decreasing over the course of time, and as a result, the government is reluctant to take any action that may result in a reaction from the general public or even from a party, or in the departure of a coalition partner. When it comes to the growing costs of energy, particularly oil, Indian administrations have a tendency to avoid passing on the increased costs to the general public, particularly during election seasons. This is because political considerations are involved. When they are done, price hikes are very minor and are scheduled with great attentiveness. The consequence of this is that public sector energy companies (and ultimately the government, which bails them out) are the ones to shoulder the losses, which contributes to India's ongoing deficits.

The Way Forward

Given that we have previously gone over the many indicators and issues about India's energy security, the following are some of the proposals and ideas that, even if they do not have the potential to provide India with energy independence, would undoubtedly contribute to the improvement of the current situation:

1. An Overall Vision and Integrated Approach

The planning process in India has a long history of being controlled by the state, which means that the state has traditionally claimed responsibility for the livelihood of its population. Elements of the Indian nationalist movement, most notably the Indian National Congress, were heavily inspired by socialist ideas of centralised planning, which were often implemented in increments of five years. India continues to have plans that are implemented in five-year increments. However, when it comes to the topic of energy, there has been criticism that this form of planning, and particularly its execution, has not provided the greatest outcomes. This critique has been made in relation to the issue of energy. Although there are some observers who do not criticise the concept of planning in and of itself, they do object to the fact that it has been "directionless," "fractious," and "ineffective," and that its execution has been "dismal." There is a want for a distinct vision as well as an all-encompassing energy plan for India.

2. Altering The Energy Mix

The numerous proposals with relation to India's energy mix are as follows: • Hydrocarbons are the answer to the problem. In order to get access, India needs to stimulate private investment inside its borders, purchase assets located in other countries, engage in oil diplomacy, and take part in initiatives such as the construction of transnational pipelines.

The use of natural gas need to be the option that is selected.

• Since India has a large quantity of coal reserves, the country need to transition away from its reliance on oil and instead focus on coal.

There need to be a strategy for diversified sourcing being implemented.

• Over the longer run, India has to significantly reduce its reliance on fossil fuels in general and place a greater emphasis on renewable energy sources such as nuclear, hydro, or solar power.

3. Self-Sufficiency

There is a significant emphasis placed on self-sufficiency in the political discourse of India. It arises from the desire of Indian nationalists to break free from the restraints of empire; the mind-set and the phrase continue to have resonance even now. Despite the fact that he concedes that it would need a great deal of effort to accomplish, the former president of India is of the opinion that it is conceivable to achieve energy independence with "total freedom from oil, gas, or coal imports." A number of policymakers in India continue to consider it a possibility, which both influences and skews the discussion. In the absence of a significant breakthrough in the utilisation of solar or nuclear energy, the majority of experts and decision makers believe that it is impossible to attain energy self-sufficiency. Even if such a breakthrough were to occur, they claim that it would still need cooperation from other countries in order to reach maximum performance. Attitudes like these need to be altered in order to be successful.

4. Diversifying Sources of Supply

A significant proportion of decision-makers continue to look for answers in other countries. While there are specialists who advocate for reducing India's reliance on oil imports, there are also some who advocate for diversifying the sources from which India obtains its oil and gas. At the inaugural meeting of the Energy Coordination Committee, the Indian prime minister, for example, emphasised the need to diversify energy supply in order “to insulate the economy from any future shock.”

5. Actions on the International Level

A small number of specialists have advocated for the government to demonstrate more initiative in foreign affairs by engaging in more intensive competition and cooperation in the international arena, as well as by engaging in "enlightened diplomacy and negotiations." There are some experts who advocate for more coordination, arguing that in a world that is increasingly globalised and interconnected, no government can freely formulate an energy strategy without taking into account the concerns and actions of people from other nations.

6. Conservation and Efficiency

There have been a number of recommendations made about the conservation of energy and the use of it in a more effective manner. This would entail, among other things, the improvement of technology, the enhancement of equipment maintenance, and the expansion of the availability of and utilisation of public transportation. In addition to advocating that the government give stronger incentives and resources for efficiency measures and associated research and development, experts have also proposed that India reform its economy to move to low-energy intensity industries.

7. Restructuring, Rationalization, and Reform

The following are some proposals that are connected to this topic: .

- The energy industry should be reorganised and liberalised.
- The tax and pricing systems should be altered, for example by adopting relative pricing of various types of fuels rather than independent pricing.
- A solution that is often suggested is to increase the amount of investment, particularly via increasing engagement from the private sector. Experts emphasise that greater energy sector expansion would need investment not just in exploration and production facilities, but also in distribution infrastructure: ports, trains, pipelines, and power transmission grids.
- Additionally, there have been proposals for the privatisation of other public sector operations, including ports, pipelines, and other infrastructure, in order to attract finance, technology, and expertise.

Concluding Observations

The most important takeaway from this piece of writing is that the Planning Commission's strategy for external commerce, foreign relations, and security should have energy security as an essential component. This is because these aspects are very important in order to guarantee the safety of the energy supply. The probability of events that affect the security of energy supply, the vulnerability of society to disruptions in energy supply, and the exposure of India to such disruptions are likely to increase as a consequence of the geopolitical constraints and developments that are expected to occur in the coming decades, according to one line of reasoning. In this context, we have demonstrated that the effectiveness of the policy instruments and approaches is not only dependent on the climate for investment, the supply of indigenous energy, the transportation and import facilities, and the access to foreign oil and gas supplies, but it is also dependent on the geopolitical environment in which these policies are required to function. However, India may discover that the time to realise a required reorientation does not match the usual process of community discussions. This is because the rising demands of a geopolitical system that is less multilateral in nature are causing India to face this possibility. It is important to note that the lack of consensus on a common direction in political-strategic problems has the potential to put the creation of an Indian strategy regarding the security of energy supply in jeopardy and to fuel the preference for unfavourable national methods. It is possible that a static, solitary approach to energy security will not be sufficient in light of the dynamic nature of international political and economic connections.

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