I. Energy transition and social impact assessment

1.1 Energy transition

Energy is a global issue. Our energy system, which is crucial to the world, is currently facing a double crisis. On the one hand, with the arrival of the peak production of natural gas and oil, the world has begun to enter the stage of declining exploitation of these resources, resulting in a resource crisis. In addition, in terms of waste, the burning of fossil fuels, coal and other fuels leads to an increase in greenhouse gas emissions and an environmental crisis, thus requiring an unprecedented worldwide energy transition for the sustainable development of human society. At present, the growth of energy consumption in developed countries is slow, as social development is gradually decoupled from energy consumption growth, and the development of distributed energy promotes a change in supply mode. With economic development, an energy science and technology revolution characterized by the deep integration of energy and information technology has emerged in this century, and with the promotion of the Paris Agreement and the 2030 Agenda for Sustainable Development adopted in 2015, a new round of energy transformation has emerged. According to energy transformation theory, policy, innovation, markets and behavior are the driving factors of energy transformation. The driving mechanism of transformation is similar across countries, and the multidimensional driving factors are parallel

Research on energy transformation has gradually gained scholarly attention. There are many studies on energy transformation and management. There is much research on the specific connotations, paths and types of energy transitions, and although relevant theoretical research has developed rapidly in recent years, there is still much room for further research.

Energy transition refers to the gradual replacement of fossil energy by new and renewable energy sources and the construction of a new energy supply and consumption system that is clean, low-carbon, safe and efficient by innovating low-carbon energy technologies, improving energy use efficiency, optimizing the energy supply structure and

transforming energy consumption behavior. It is also assumed that the energy transition is not only a process of reshaping the energy system and replacing the "old" energy with "new" energy but also includes changes in the socioeconomic system.

Thus, the energy transition is widely considered not only a matter of energy systems but also an issue involving socioeconomic systemic changes, such as structural changes in the economy, regional revitalization, industrial transformation, and worker retraining, and even influencing international relations through foreign investment and the energy trade. This shows that the energy transition is a major change that integrates economic, technological and social aspects. An energy transition is essentially the replacement of traditional fossil energy with renewable energy, but because the energy transition system involves different aspects and stakeholders with different interests, a suitable path for the energy transition should be developed according to the actual situation.

Energy transition is an important means of carbon emission reduction and a key factor affecting the low-carbon transition of the whole society. This transition requires complex sociotechnical changes with multifaceted and far-reaching implications, bringing enormous benefits and risks. The benefits include a more democratic and resilient energy system, industrial restructuring and technological progress, the alleviation of energy poverty, and attention to social and environmental legal issues within and between countries.

Of course, the energy transition has positive effects on people's health, the global climate and energy security. However, there are also negative impacts of the energy transition, which are present in all aspects of the economy, politics and even ideology and social conduct.

The decline in traditional energy sources has resulted in massive job losses for workers in traditional energy industries, creating instability in social security. It can also exacerbate regional imbalances in development. The injustice of the energy transition may also be reflected in the uneven distribution of benefits created by "green energy" that do not reach marginalized groups. Thus, a "just" energy transition is necessary for continued transformative development.

1.2 The just energy transition and its social impacts

In addition to its positive environmental impacts, the energy transition also has social consequences. For example, the effects of higher electricity prices, which are partly the result of the levy for renewable energies, are felt most sharply by low-income households
The expansion of renewable in the sake of a safe energy transition needs large funding. This could be a burden on national financial resources. But there is no way round the expansion of renewables. “They are a key element of the energy transition,

It is shown that a large proportion of the increase in electricity prices is the result of taxes and levies – especially the EEG levy that is imposed to fund the expansion of renewable in the UE. “Between 2008 and 2018 the levy has increased from 1.17 to 6.79 cents per kW.h,”. This means that the poorest households spend a significantly larger proportion of their income on the EEG levy than the most affluent ones.”

At present the design of the renewable energy system is not entirely fair – for instance with regard to the cost burden and the many exceptions for industry.” Private households can of course benefit from the expansion of renewables – for example, by installing their own solar thermal collectors. “High-income households have an advantage here because they can afford to invest in systems of this sort and are also likely to own their own homes and thus be entitled to install such systems, these households have significant energy-saving potential. “However, these consumers are not usually swayed by the cost argument

This means that many people on a low income are at risk of energy poverty. “Basically it refers to the link between energy costs and poverty when people can no longer afford the cost of electricity and heating or when they risk being driven into poverty by these costs.

Some measures could help improve the social fairness of the energy transition. such as enhanced consumer protection measures to prevent disconnection of gas and electricity supplies “But it is also clear that there are no simple solutions that have an impact in both the short and long term and that take all relevant target groups into account.

For a long time, fairness and distribution issues were barely considered in discussion of the energy transition, but they are now a firm component of political discourse," "The topic is finally being addressed in energy and climate policy." The next step, involves improving coordination between social policy and energy and climate policy. "Energy policy cannot be social policy, but it must take account of distribution effects and must not exacerbate existing inequalities,"

1.3 The just energy transition and its social impacts

"Energy justice" is defined as a global energy system that distributes the benefits and costs of energy services equitably. In the field of energy and climate, the concepts of "environmental justice," "climate justice," "development justice," and "energy justice" have received attention in recent years.

- ***"Environmental justice"*** is defined by as the distribution of environmental hazards and access to all natural resources, including protection from burdens, meaningful participation in decision-making, and equity in benefits.

- ***"Climate justice"*** is about recognizing those who are primarily responsible and those who are victims of the current climate problem and seeking a reasonable division of responsibility for reducing carbon emissions.

- ***"Development justice"*** seeks to achieve the free, comprehensive and harmonious development of human beings so that the fruits of development can benefit everyone from the beginning, throughout the process and in the results of development. "Energy justice," which is centered on the idea that all individuals should have access to affordable, safe, sustainable energy that sustains a decent life, as well as the opportunity to participate in and lead energy decision-making processes and have the power to make change, is a key concept in the just energy transition.

The concept of a just energy transition originated in the trade union movement of the North American energy sector in the 1970s. The

widespread dissemination of this concept occurred in the 1990s with the formation of the Just Transition Coalition. Thus far, a "just energy transition" is vaguely defined as a situation where all groups have access to affordable, safe and sustainable energy and can maintain a decent lifestyle, have the opportunity to participate in the energy decision-making process, and enjoy the right to make changes it is suggests that as fossil fuel activities decline, workers dependent on such activities will face negative economic and social consequences; mitigating these impacts and incorporating socioeconomic considerations into the energy transition is often referred to as a "just energy transition."

Five themes around the concept of a just energy transition are discussed:

a) ***First, transition is a labor-oriented concept***. The concept of a just transition emerged from the labor movement, which saw the environment and the fate of workers as intertwined and decided to advocate for a just transition.

b) ***Second, the just transition as a comprehensive framework for justice*** includes three dimensions:

- environmental justice,
- climate justice,
- and energy justice

Of these, environmental justice and climate justice share three principles of justice: distributive justice, recognition justice, and procedural justice. Climate justice is also concerned with intergenerational justice. All three justice frameworks emphasize distributive justice and procedural justice and agree that, despite the urgent need for transition, such a transition must be just and equitable in its effects and implementation.

c) Third, just transitions are sociotechnical transitions. The global low-carbon transition is not only a sociotechnical issue but also a social equity issue.

d) Fourth, a just transition is a governance strategy. Emphasis is placed on the need to study governance methods.

e) ***Fifth, the just transition from the perspective of public perceptions*** explores public and community attitudes and the social impacts of a just energy transition.

Different countries, with different economic and social development and different cultural histories, adopt different measures to promote a just energy transition according to their own characteristics. To promote a just energy transition,

- China proposes policy measures that are tailored to local conditions, integrating environmental protection and economic development, planning ahead for an early and orderly withdrawal from fossil energy use, and establishing a transparent and inclusive decision-making and implementation mechanism

- Australia has established a regulatory framework for a just transition, including the three criteria of financial support, green jobs for workers, and union and community participation, and increased exploration for better management practices to improve the likelihood of just outcomes.

- The Netherlands proposes integrating local values and ideologies with renewable energy practices and policies with local support.

- Greece builds on a multilevel perspective to become sustainable and social justice in the post lignite era, proposing measures to create new jobs and innovate in mining lignite and aiming for increased government investment in the clean sector and citizen participation.

- The United States proposes four measures to build resilient communities, create sustainable jobs, engage affected workers and communities in collaborative efforts, and secure long-term investments from a variety of sources; it also proposes to protect children's rights and develop education.

Existing research on the social impact of a just energy transition is still at the conceptual and concrete response levels. According to Rawls' theory of justice, in essence, justice consists of having a certain degree of care for the interests of vulnerable groups under the premise of equal civil liberties and rights, while the equality of the basic rights of citizens is a higher priority and more important.

1.4 How can the social impacts of a just energy transition be assessed?

Social impact assessment is defined as "the process of determining the future impact of current or proposed actions on individuals, organizations, and macrosystems of society." It identifies future consequences of current or proposed actions that are relevant to individuals, organizations, and the broader system of society.

The impacts of a just energy transition are also multifaceted. For example, regarding the assessment of the social impact of a just energy transition one can cite the mining sector as an example of its positive and negative effects in six areas: the economy, income and security; employment and education; land use and territorial aspects; population mobility; the environment, health and safety; and human rights.

The energy transition faces different challenges in different countries due to differences in social, economic, political, and cultural contexts.

The relationship between justice and stability is characterized by difference, synergy, dynamic balance and overall optimization . Social injustice will increase the factors of social instability, and the injustice of energy transformation will lead to social instability. In the process of energy transformation, due to the lack of compensation for lost employment opportunities, some people are unemployed, which in turn increases the risk of social conflict.

It is necessary to point out that necessary actions such as closing coal mines can spark a conflict in local regions, therefore the transition must be done carefully and with eyes on the social dimension of the problematic. the companies that produce renewable energy can be helpful in mitigating the consequences of the energy and climate crisis: **about 500 000 new jobs could be created by 2025**. However, there is a need for investment to upgrade the skills of workers.

Using tools to assess the risks of social instability and then providing risk avoidance suggestions can promote social equity. In particular, the project of a just energy transition, which has a long construction cycle, involves a wide range of areas and is related to the complex real social system.

Therefore many social factors can be taken into account in advance to avoid or reduce problems. Especially for the project of just energy transformation, which has a long construction cycle, involves a wide range of areas and is related to the complex real social system, referring to the views, in the preparation and planning stage of the project, How to incorporate the tool of social stability risk assessment into the social impact assessment of the energy transition deserves further exploration.

In general, assessing the social impacts of a just energy transition should follow a social impact assessment methodology that identifies future studies of the energy transition on individuals, organizations, and social macro-systems, and reasonably assesses the impacts of a just energy transition in terms of economy, income, and security; employment and education; land use and territorial aspects; population mobility; environment, health, and safety; and human rights.

1.5 Policy recommendations for a just societal ET

Simply decarbonizing the status quo is not energy justice, and justice and democracy cannot be ignored in the energy transition. The nations of the world should provide energy to those who do not have it, justice for those who work in and are affected by the fossil fuel economy, and try to manage the potential contradictions that can arise from pursuing energy and climate justice simultaneously.

At the practical level, specific measures to promote a just energy transition vary from country to country, but the basic measures should include creating new jobs, developing a new economy to facilitate the transition, encouraging community, trade union and public participation and understanding, increasing financial support to obtain investment, and protecting the legitimate rights and interests of the public.

Policymakers should integrate climate, energy, social and structural policies and recognize local circumstances and global linkages to help guide a just and timely transition to global sustainable development. What is needed for a rapid policy shift is not a large target of net zero carbon by 2050 but a clear milestone. In terms of the energy transition in developing countries, the theory of latecomer advantage can provide good lessons to introduce technologies and equipment from advanced countries, save research costs and time, rapidly advance social development from a higher starting point, accelerate the use of clean energy, and promote leapfrog economic and social development.