How Can Green Technology Be Possible

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Abstract

According to the basic forms of inquisition into the possibility of green technology, we have to commence from three aspects in order to resolve the issue of how could green technology be possible. Firstly, to analyze the ecological paradox of technology per se so as to solve the question of whether a technology can be green. Secondly, to make clear the premise for a technology to be green and the standards of green technology to solve the problem of how the technology can be green; Finally, we must start with the ecological assessment of green technology and draw a clear distinction of the green technology to resolve the problem of how green a technology is.

Keywords: Green technology, Possibility, Inquisition

The concept of Green Technology (Note 1) originated from the social ecological movement of western industrialized countries in 1960s and 1970s. Green technology refers to the generic terms of technology, industrial art or products which can reduce environmental pollution and diminish employment of raw materials, natural resources and energy. Generation of this concept rooted in reflection upon destruction of the ecological environment and threat to human beings' survival by modern technologies, and can be regarded as one of the symbols of emergence of ecological philosophy, ecological culture and ecological civilization. Considering the status quo of research on green technology both at home and abroad, it seems that green technology has already been widely accepted after entry into the twenty-first Century, and most researches focus on specific fields, such as green technology innovation, green technology development and green technology expansion, etc, while philosophical reflections upon and inquiry into green technology become fewer. This, obviously, is neither helpful for in-depth understanding in green technology nor favorable for further development of green technology. In this article, the authors are going to start from the immanent contradictions of the concept of green technology and explore the basic problem of "how can green technology be possible"

1. The ecological paradox of green technology: whether a technology is green?

In terms of grammar, green technology is a modifier-head construction, in which the word "green" is used to modify or define "technology", and its opposite ought to be non-green technology or anti-green technology. This means that the issue of green, non-green or anti-green does not exist in technology itself. However, we can judge whether a technology is green by determining the relationship between the technology and the ecology, that is, protection of the ecology, destruction of the ecology or neither of the two. Whether it really turns out to be true?

First of all, let's start from definition of technology. There are quite a large number of definitions of technology, which can be generally summarized into four definitions. The first definition is to regard technology as a capacity of human kind, that is, "an entirety of all sorts of skills employed by human beings to change the environment". The second definition is to take technology as a sort of knowledge, that is, "an object and process to control, reform and create the nature according to a valuable practical purpose and summation of knowledge to accept constraints of scientific methods". The third definition is to consider technology summation of systems or means of material means to realize a certain purpose. The fourth definition is to understand technology as summation of knowledge, capacity and means. No matter which of the four definitions is adopted to look upon technology, the target is locked on opposition to the nature, that is, to treat with the nature and natural rules as the object, which is the origin of the so-called modernistic subjective and objective thinking mode, and is also the root of all negative factors correlated with the nature, the ecology and the environment, etc. The logic of technology is the logic of anti-nature and anti-ecology, because technology, especially modern technology has its

feature of anti-ecology or being adverse to the ecology in the setting of its target. In this sense, technology and green are an opposite pair, and the concept of green technology is a paradox in the aspect of the ecology: technology can not be green.

Then, let's have a look at conceptions of methods and approaches by human being to resolve the ecological issue. According to some people, in order to resolve the ecological issue in modern society, the unique way is to abandon technology and come back to the original state, which is believed to be similar with the technological pessimism of Chuang-Tzu, without any realistic possibility or feasibility. According to the optimism, technology is believed to be able to resolve issues brought about by technology itself, which is suspected to seem to be dogmatism of self proving. By contrast, the emergence of the concept of technology surpasses the above two trains of thought, which holds that so long as a technology can alter the feature of anti-ecology of the target set by itself or can set an ecological target, then it can resolve its anti-ecology to a certain extent. However, pure change of the technological target can either make no contribution to the natural character of the technology or can not succeed in changing the destructive consequences of technology to the ecological environment.

As a matter of fact, there is only one method to resolve the ecological paradox of green technology, that is, to correctly understand the concept of green technology. The green in green technology ought to be understood as an orientation and a standard of judgment on value. The internal logic of green technology should be within the scope of people's knowledge and competence. On the precondition of not doing harm to existing social productivity and the living standard of human beings, we should attempt to diminish any destructive consequence caused to the ecology by technology and production that may endanger survival of human kind.

Correct understanding in green technology mainly includes four aspects. Firstly, we must come to realize limitation of green technology. Since human beings' knowledge of the nature and the natural ecology is limited, the competence of protection on and recovery of the ecology by technology based on limited knowledge is also confined. Influences of technology upon the ecology are both short term and long term. Short term influences are easier to discover, whereas long term influences are difficult to judge. Secondly, green technology is a dynamic concept. On one hand, in the process of social development, influences of technology on the ecological system and the carrying capacity of the ecological system have always been in alteration, so green technology at this time may have become non-green technology by that time and green technology at this place may become non-green technology at that place. On the other hand, technology and the ecological system are also in continuous alteration. Knowledge and judgment of "green" by human beings and governing of the society on technology are also in alteration. Therefore, connotation and denotation of green technology is also in continuous alteration and development. Thirdly, we must also come to realize complexity of green technology, which is mainly manifested in two aspects, namely, breadth and depth. In terms of breadth, usually, improvement of technology may lead to multiple effects, such as, environmental effect, economic effect and social effect, etc, and lead to complicated and non-linear comprehensive influences. In terms of depth, relationship between technological improvement and environmental effect is not only confined to the superficial phenomena, and technology has a covering, overlapping and accumulative effect upon the environment, so we should go into further analysis and study. Finally, in practical industrial production, we ought to regard green technology as integration of a series of related knowledge systems. The theoretical system of green technology includes a series of related concepts, technologies, procedures and methods, such as green concept, green design, green production, green management and rational treatment, etc.

2. Boundary of green technology: how can technology be called green

Since green in green technology is merely a comparatively termed directed concept, then there exists the issue about the standard to judge whether technology is green, that is, what kind of technology can be termed as green technology? What is the standard to classify and judge green technology?

In order to discuss the judgment standard for green technology, we have to firstly realize the fundamental condition for establishment of green technology, that is, theoretical precondition and theoretical basis of green technology. The first precondition is generation of awareness of green. In the earlier 20th Century when the material wealth of human beings grew sharply, ecological problems and environmental problems which posed threats to subsistence of human beings became more and more serious and people were more and more aware that problems existed in the traditional industrialized path and traditional economic growth pattern, and even the life style and ideology. "Our National Parks" by John Muir in 1901, "Sand County Almanac" by Leopold Aldo in 1949 and "The Limits to Growth" by the Club of Rome in 1971, all these research achievements which reflected awareness of green continuously washed out and eradicated traditional concepts and ways of thinking caused by industrial civilization and continuously penetrated into all fields in daily life. Awareness of green is a new

thinking pattern and idea that brings us to new awareness of relationship between human being and the nature and is the outcome to reflect relationship between human being and the nature, relationship between human being and the ecology and relationship between human being and the environment. At the same time, awareness of green is also the symbol for human being to transit from industrial civilization to ecological civilization, and is the great background for generation of green technology. The second precondition is development of ecological science. The modern industrial technical principle and mode before emergence of green technology was established on the basis of physics and chemistry, but was lacking in the basis of ecology. "This is just like a stool with two legs. It may be proved to be fine in physics and chemistry, but would turn out to be disabled because of the loss of the third leg which refers to ecology in the environment." Development of ecological science enables human kind to come to realize fragility of ecological environment and come to know the basic methods and principles to maintain and recover the natural ecology, expands their competence to grasp the system of "technology-nature", and makes intervention and involvement of ecology in technological development possible. The third precondition is transfer of technological values. Traditional technological values is economism values based on instrumental rationality, which holds that the fundamental purpose of technology is for convenience and comfort of human survival. This sort of values takes the nature as the tool for employment by human kind, which ought to be inexhaustible, so it has strong anthropocentrism value orientation. Transfer of technological values to green means that we have to start with the basic principle of ecological economy, rationally explore and scientifically employ natural resources, respect the internal value of the nature and realize the harmonious development and coordinated evolvement of human beings and the nature.

According to the life cycle of technology per se, the judgment standard for green of technology can be classified into three sorts. The first standard to judge green technology is the technological target set by this technology. Compared with ordinary technologies, green technology has to take into consideration ecological factors at its stage of design and research & development. Any form of design can be termed as eco-design that coordinates with the ecological process and attempts to reduce its damage to the natural environment to the minimum. This sort of coordination means that the design has to respect diversification of species, reduce pillage of resources, maintain nutrition and water circulation and preserve quality of the natural environment so as to improve settlement environment and health of the natural ecological system. The primary design principles include the principle of unity, the principle of coordination and balance and the principle of circulation and regeneration, etc. The second standard to judge green technology is the ecological influences of this technology in the process of its application. Although research and development of green technology is aimed at alleviating damage to the ecological environment or recovering the natural ecology, in its practical application, there is still the possibility of damaging the ecological environment. There are two possibilities here: one is that employment of green technology may result in mild destruction to the ecological environment than non-use of green technology, such as clean production technology and the other possibility is that new poisonous and harmful substance may be generated in processing poisonous and harmful substance in production. The third standard to judge green technology is the ecological consequence of this technological product.

Judgment standard for green technology can also refer to influences of technological activities on the ecological environment, that is, green technology has to be equipped with realistic ecological functions. As for the ecological environment, the ecological functions of technology mains include two aspects, one being to diminish or alleviate damage of existing production process on the ecology and the other being to recover or re-build the ecological environment that has already been damaged.

3. Assessment on green technology: how green a technology is?

After we have judged whether a technology is green and have asserted that this technology has green factors, there also exists the issue of how to judge the degree of green of the technology, that is, the issue of how to assess the ecological effect of the green technology. At present, the system of assessment on green technology includes four sub-modules: assessment on technological effect, assessment on ecological effect assessment on economic effect and assessment on social effect. Assessment of ecological effect is peculiar to green technology and is also the symbol for real generation and formation of green technology. The process of ecological effect of green technology mainly includes the three stages of ecological identification, ecological diagnosis and ecological evaluation. Ecological identification is to make a qualitative distinction on interferences of technology to relevant ecological environment and to make a scientific evaluation on influences of all sorts of environmental factors, including definition of the purpose and scope, analysis of the boundary of the system and functional units, qualitative and quantitative assessment on environmental influences and analysis of the improvement, etc. After having had a preliminary knowledge in ecological environmental influences of technology by means of ecological identification, we can go on further to make an ecological diagnosis in green technology to confirm

the primary ecological influences and sources of green technology, understand the specific mechanism of green technology in its effect in the ecological environment and establish specific ecological evaluation method and mechanism.

Fuzzy evaluation method is to make a simple classification according to the ecological functions of green technology. In 1994, USA Environmental Protection Agency classified green technology into dark green technology and light green technology (Note 2) in its scientific plan. Dark green technology refers to the technology of pollution abatement. For instance, polymer gas ion film is used to concentrate, recycle and combust CO2 in waste gas, and the concentration of CO2 can be concentrated by ten times and thus be used as chemical raw material. Light green technology refers to cleaner production and comprehensive utilization technology of conserving energy and resources, etc, such as electric vehicle technology, etc.

For the time being, the mostly adopted methods employed in the academic field for ecological assessment are life cycle method and ecological footprint method, and these two methods take the following as the assessment subjects: technological system, product consumption, production process and even industrial activities and regional economic system, so they are more applicable to macro industrial activities and long term economic consequences. Methods of ecological assessment on a specific technology include ecological marginal cost analysis method and emergy analysis method, etc.

Protection and recovery of the ecology by green technology is affected and restricted by economic factors and the most critical one is marginal opportunity cost (abbreviated as MOC). Marginal cost represents the increase of the total cost with gain of 1 unit in yield. Generally speaking, with increase of the yield, the total cost increases degressively, so the marginal cost reduces, that is, the scale effect. Opportunity cost refers to the fact that under the circumstance of limited resources, the value of other activities has to be abandoned in order to participate in one certain activity. According to the basic principle of economics, MOC=MPC+MUC+MEC, in which MPC represents the marginal production cost, MUC represents the marginal employment cost and MEC represents the marginal external cost.

Emergy analysis method takes energy conversion of technology as the subject, analyzes the degree of influences of green technology upon energy changes of the natural ecological system and its major index is the (solar) emergy that can be universally used between the economic systems of the natural and human society. According to the basic principle of emergy analysis, Emergy (sej) = Transformity (sej/J) of the emergy × Energy (J). The emergy transformity deducted from emergy can convert all sorts of energy (substance) into emergy with the same property, so as to make a quantitative analysis of all kinds of energy flow and substance flow, and can even make a comprehensive analysis of the energy flow, currency flow and other substance flows generated by green technology by means of emergy index system.

A general survey of all sorts of methods of ecological assessment in green technology, is it not difficult to discover that the key of green technology assessment is the green coefficient (abbreviated as L) which takes the ecological effects of technology or the technical capacity of the ecology. According to understanding in green technology, the purpose of green technology is not purely to protect the ecology and recover the natural appearance of the ecology, but to maintain and improve human kind's survival competence and living standard within the admissible sphere of the natural ecology. Thus, the core of green coefficient is to observe and analyze the proportion (abbreviated as B) of influences of technology upon the ecological environment to the load of the ecological environment, which includes the two dimensions of time and space. The dimension of time refers to the rate of contribution of green technology to the ecological environment, which is represented by the formula: L1=B/T, in which T stands for time. The dimension of space refers to the rate of contribution of green technology to the regional ecological capacity, which is represented by the formula: L2=B/K, in which K stands for space.

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Notes

Note 1. Also termed as Environmental Sound Technology (abbreviated as EST) or Ecological Technology.

Note 2. Green Science and Technology. Applied Science and Technology, 1998, No. 8.