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Eco-Innovation as a New Sustainable Development Strategy: Case Studies

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***Abstract*—**Sustainable development is one of the most debated issues, recently. In terms of providing more livable Earth continuity, while Production activities are going on, on the other hand protecting the environment has importance. As a strategy for sustainable development, eco-innovation is the application of innovations to reduce environmental burdens. Endeavors to understand eco-innovation processes have been affected from environmental economics and innovation economics from neoclassical economics, and evolutionary economics other than neoclassical economics. In the light of case study analyses, this study aims to display activities in this field through case studies after explaining the theoretical framework of eco-innovations. This study consists of five sections including introduction and conclusion. In the second part of the study identifications of the concepts related with eco-innovation are described and eco-innovations are classified. Third section considers neoclassical and evolutionary approaches from neoclassical economics and evolutionary economics, respectively. Fourth section gives the case studies of successful eco-innovations. Last section is the conclusion part and offers suggestions for future eco-innovation research according to the theoretical framework and the case studies.

***Keywords*—**Sustainable Development, Innovation, Eco-innovation, Neoclassical Approach, Evolutionary Approach, Case Studies

I. Introduction

THE pace of eco-innovation processes toward reducing environmental burdens must catch and surpass this rapidity of environmental pollution. If this process is managed poorly, the results will appear irreparable. In this context, the success of the economic system is to create sustainable economic processes [1]. Therefore, it needs understanding the eco-innovation processes very well and it is very important to implement the theoretical and practical information immediately.

The issue of eco-innovation is usually approached in terms of the technological perspective. This also results in a phenomenon termed "technological prejudice". In order to be rid of this prejudice", It is necessary to examine the points such as the nature, sorts, varieties, and taxonomy of eco-innovations so that eco-innovations can be made to be understood better.

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Naturally, it needs including the determinative factors of eco-innovations in this investigation. The development of new tools and methods are needed in order to achieve sustainable development within the framework of eco-innovations.

The dominant approach used in stimulating eco-innovations until today is neoclassic approach. Departing from shot-termed equilibrium approach of neoclassic view, several instruments are used. These instruments are those obtained from environmental economy and innovation economy, the extensions of neoclassic economy.

Recently, in order to investigate the situations of long termed unbalance the traditional neoclassical approach did not foreseen, the contributions that evolutionist economic theory can make to eco-innovation study are considered. Because of holistic approach, evolutionist approaches becomes an issue to a number of investigation in terms of satisfying a theoretical approach. Even though neoclassic approaches can be used for short termed marginal changes, in order to understand how long term radical system changes will be created, evolutionist approaches are used.

Advantages and disadvantages of both approaches should be evaluated together. Successful examples of eco-innovation in this area will help to create a new roadmap. Hence, the aim of this study is to introduce the successful eco-innovations with case studies. In this context, case studies of eco-innovations leading to marginal changes as well as eco-innovations leading to radical changes were performed. As a consequence of these case studies, the suggestions are tried to be developed toward the studies off future eco-innovation.

II. Defining Eco- Innovation

In the literature, as well as the classification of eco-innovations in eco-innovation related concepts, there are important developments in recent times. Sustainable development - While the needs, on the one hand, are protecting the environment in such a way that it can be met not only by the present generations but also the next generations, on the other hand, they are patterns of using resource aiming at satisfying human's needs.

According to the definition of Brundtland commission, sustainable development is the development meeting the existent needs, without the ability of next generations to be able to meet their own needs [2],[3].

In Oslo Guideline of OECD, process, product, and innovations are discriminated. According to this, process innovation is achieved when the amount of output (product, services) given are produced by less input.

Product innovation entails the improvement in existing products and developing the new products. Organizational innovations encompass new production styles such as total quality management [4]. Innovation is different from invention, because, while the invention was a new opinion or model for an improved product or a process, an improved

product or process becomes innovation, when they are first introduced to the market. The third stage is diffusion stage, which innovation is used and adapted in the process of time [5]. The definition of OECD about innovation, when we classify the innovations technically and organizationally, includes social and institutional innovations.

Eco-innovation – A number of definition of eco-innovation was made, and among these, according to the definition made European Commission, eco-innovation is every kind of innovations which can be sustained by reducing its effects on the environment and obtaining the use of natural resources, including energy, more effectively and efficiently, and which aims important and demonstrable advancement toward development [1]. When we evaluate according to the definition of eco-innovation presented above, eco -innovations can be divided into two categories; environmental innovations and non-environmental innovations. In terms of sustainable development, environmental innovations gained importance. According to any classification, we can classify the eco-innovations as technological eco-innovations, organizational eco-innovations, eco-innovations associated with business parks, and social innovations. As an example for technological innovations, solar energy and wind energy can be given. The new forms of organizational concepts such as sharing car are of examples of organizational innovations [6]. The example of eco-innovations associated with business parks is eco-city closing cycle in Japan, Hyogo [7], realizing zero –waste industry by the use of by products, wastes, and recycled materials as input from different industries to the production. A more environmentalist life style and innovations associated with the habits of consumptions, and accepting the new arrangements such as Renewable Energy Act can be given as examples for social eco –innovations [8]. For example, alteration toward using bicycle, instead of using car, is also a social innovation.

Also, we can divide the eco innovations into three categories as End of Pipeline Pollution Control Technologies, Integrated Clean Production Technologies, and Environmental R&D. End of Pipeline Pollution Control Technologies are used for handling, measuring, treating, or eliminating the production emissions and wastes by production firms. These technological solutions are integrated to the existent production process in the final stage and are not being considered main part of production process. End of Pipeline Technologies leave the production process without modifying and are evaluated as high degree of marginal innovations. Because they are not regarded to as main technologies, end of pipeline technologies are perceived as costly investments undermining the abilities to be able to compete by the firms. Integrated Clean Production Technologies express the new or modified production possibilities being more effective compared to the previous technologies, reducing the amount of input for production and/or substituting the inputs with more friendly alternatives, contributing to reduce the environmental pollution.

The main difference between these technologies and end of pipe line technologies is that they are basic parts of production process and thus, they generally represent the environmental process innovations.

Integrated solutions are focused on preventing from polluting, applying the philosophy of "looking forward, predicting, and preventing". The main aim of environmental-R&D, providing cleaner production and consumption solutions, is to improve the products and processes. The production firms conducting environmental R&D in systematical basis try to increase their knowledge in the area of environmental protection and to use this knowledge for designing new applications [9].

Another classification about this issue is that made by Andersen. According to this classification, eco-innovations are divided into 5 categories. There are extension eco - innovations, integrated eco - innovations, alternative product eco-innovations, macro-organizational eco-innovations, and general purpose eco- innovations.

Extension eco-innovations are the products (or services) improving the general environmental performance of customer. There is no need that the product itself becomes environmental friendly. These innovation are environmental solutions in part of pool (a number of technologies and services cleaning emissions, diluting, recycling, measuring, controlling, and carrying the emissions) and source (deriving the natural resources and energy). These technologies and services are produced by environmental technologies. Since they are added to the existent production and consumption applications (without largely influencing them), their systemic effects are limited.

Integrated eco-innovations (clean technological processes and clean products) make the production process or product compared to the similar processes. They contribute to be solved the environmental problems within companies or the other organizations (public organizations, families). Especially in the companies, they ate innovations contributing to changing of production and consumption applications. In spite of this, they represent the technological permanence. They regard to greening as a movable target. Alternative product eco-innovations (new technology ways) are the innovations representing the radical technological discontinuity. They are not cleaner compared to the similar products, but offer non-problematic solutions (via new technology) as a very different environmental [structure]. These radical product innovations have broad systemic effects. They are built on the new theories, possibilities, and practices and they require changing both product and consumption patterns.

Macro-organizational eco-innovations (new organizational structures) express the new solutions for eco-effective ways of affecting the society. This refers to the new ways considering our product and consumption in more systematic level. Like companies, between organizations; between families and workplaces, it expresses the new functional interactions ("industrial symbiosis") and the new ways of organizing the cities and their technical infrastructures. They may be radical conceptually, but there is no need for them to be radical technically. They emphasize the importance of spatial dimension of eco-innovation and involve organizational and institutional change. These innovations are generally under control of public authority. General purpose eco-innovations are an important part of the technological landscape, often to the extent that they give their name to an era.

We had a steam engine era, the steel era and now we have an information and communication era. Perhaps the next era is the era of nanotechnology or biotechnology [10].

III. Theoretical Framework

Until the recent time, the generally acceptable economic theory for eco-innovations was the neoclassical theory. While innovation economy, the extensions of neoclassic economy, were guiding the innovations economies, environmental economy guided the environmental policies. Since the importance of eco-innovations in sustainable development strategies is now generally acceptable, the discussions to stimulate the eco-innovations, and about what the right polices should be done continue. On this issue, in addition to the situations of neoclassic economy in short termed balances, in order to analyze long termed balance dynamics, the contributions of heterodox economic theories are begun to be analyzed and especially, the discussions on the contribution of evolutionist economy to the long termed dynamic of eco-innovations continue. Apart from the innovation economy and environmental economy of neoclassic economy, as a new approach, evolutionist economic approach is used. Below, it is touched on the importance of these theories in understanding and stimulating the eco-innovations.

A. Eco- Innovations in Neoclassic Economy

With neoclassic approach, in the situations of equilibrium, marginal changes can be described. Marginal changes can cause way dependencies and locking. In spite of this, in terms of that it explains the commonly reefed methods in our present days, it is important to understand the neoclassical approach. Eco –innovations enters the study area of two branches of neoclassic economy. These are environmental economy and innovation economy. The effects of these two disciplines in creating the effectiveness an eco-innovation are important. While environmental policy is making use of environmental economy, innovation policy also makes use of innovation economy. Below, it will be touched on the dimensions of eco-innovation these two disciplines.

B. Environmental Economy

For stimulating the eco-innovations from environmental economy, the dominance of market based instruments (such as taxes, and marketable licensees) were accepted for a long time. These instruments were evaluated as the instruments of environmental policy with the highest effectiveness their advantages are their providing the permanent motivations for cost effective emission reductions. However, a generally acceptable rule formed in the way that the command regimes organized by technical standards and the regimes of voluntary agreements are not effective and advancement motivations disappeared after satisfying the standards. The exceptions of these can also be Rennings, 2000. The statements of economists in the way that pollution taxes and emission process systems is better about stimulating eco-innovation is only valid for innovative changes, non –innovative or innovative in marginal level [11].

Before 1990s, environmental showed the tendency of becoming voluntary based on the negotiation, mostly reactive and informal, and often, between industry and government. Understood the importance of technologies for environmental protection in the 1990s and developed the concept of integrated pollution prevention and control. But instead of developing the production and disposal processes, focused on end of pipeline technologies. Hence, positive effects of environmental policies on innovation remained limited in the past, because conditions dependable arrangements and standards do not sufficient amount of incentives to the firms for making innovations beyond end of pipeline technologies. In spite of this, typically, in order to reduce the environmental effects, higher costs were applied on the firms compared to the other policies. With the market instruments such as “green” taxes and marketable licensees in the recent years, even if more costly effective actions placing a price on “bad” emerged, if eco-innovation will realize its own potential, in order to obtain that full cycle of innovation should be effective, the polices ranging from supporting the investments, suitable for research, to commercializing epochal technologies will be necessary [12].

One of the famous views about environmental policies is also Porter Hypothesis. Because of negative external effects characterizing a number of environmental problem, environmental problems are less market –motivated at least compared to the other problem and thus, environmental policy is one of main drivers of environmental innovation.. According to Porter Hypothesis, environmental policy can lead to the situation of win-win and so pollution decreases and profits increase. Porter Hypothesis is greatly based on evolutionist innovation theory. Since there are great ambiguities associated with the success of R&D, according to this theory, firms uses the rule of thumb in their respective innovation behaviors. Therefore, innovation activities are not optimization processes. The firms do not perceive the potential of environmental innovation, because they have no experience about endeavoring in a creative way with environmental issues. The environmentally and economically benevolent innovations cannot realize because of missing information, and organizational and coordination problems. The firms are not aware of cost -saving potential of environmental innovation (for example, energy and material saving). Hence, environmental arrangements “must force” the firms to realize the environmental innovations, economically profitable. The “moderate” environmental actions such as environmental accounting systems or eco-auditing will also be information base for environmental innovation. Until now, there is no persuasive evidence for Porter Hypothesis. Furthermore, theoretical literature is highly suspicious about its correctness [13].

C. Innovation Economy

In innovation economy, positive externalities created by eco innovations are considered. These externalities are existent in both the stages of innovation and diffusion. In diffusion stage, when positive externalities are compared with the competitive goods and services in the market, they emerge because of lower amount of external costs.

Rennings names these externalities as “Dual Externality Problem” [5]. According to him, this externality problem

leads to the motives of firms to invest on eco-innovations to decline. Hence, it is necessary to coordinate the environmental policy and innovation policy. Innovation policies can be achieved thanks to financial support for pilot projects. Therefore, technological, institutional and social innovation costs can be reduced during the processes of production and supply of a commodity. Certainly, environmental policy, at least in the stage of diffusion, can punish the environmental effects and thus, can internalize the external cost of non-ecologic products.

In innovation economy, the studies have focused on whether or not technological developments (push of technology) or demand factors (pull of market) are more important motives of technological innovations. According to what empiric studies showed, both of them are correct. While the push of technology is more important at the outset of product cycle, market prices becomes more important in the next stages. In spite of this, a feature of environmental innovation is that push of technology and pull of market may be relatively weak and it needs a "regulative push (effect of pull)". The meaning of this is the necessity of regulative frame [14]. Here, push of technology, pull of market, and regulative push/pull emerge as the determinatives of eco-innovations.

Policy instruments from both environmental economy and innovation economies must be coordinated. While providing this coordination, first of all, the tax and innovations systems of country should be examined. Hence, in these two systems, the policies warning environmental innovations should be included. Thus, whether or not there are warning and impeding situations the eco-innovations should be examined. From now on, separately using the environmental and innovations policies, for example, tax policy and subvention policy, is not enough. In this case, one of the most important factors, which should be taken into consideration, apart from public benefits, is the specific benefits to be obtained from innovation activities. Any firm cannot endure to the cost of innovation so that it should only be useful to the public. What is important for firms in order to gain competitive advantage?

D.Innovation in Evolutionary Economics

While neoclassic approach can predict the short termed deterministic marginal changes, it remains insufficient in predicting the long termed marginal changes.

While the evolutionist approaches, on the one hand, are attempted to describe the economic innovations with the selection mechanism, similar to natural election, they borrowed from evolution theory in biology, on the other hand, they are interested in analysis of the transition and learning processes and they assume the rule of thumb and limited rationality, instead of optimization. The main methods are case studies and successive analysis [5]. Selection mechanisms are not only limited by one-parted evolution but also equal evolution appears. Eco systems and social systems can undergo equal evolution and there are complex feedback mechanisms between them. When these feedback mechanisms initiate interchange process, equal –evolution appears. This refers to equal- evolution paradigm.

There are also some criticisms against biological analogy used in evolutionist approach. For example, according to Foster [15], "in modern evolutionary economics, the commonly use of biological analogy leaded to a literature, which does not provide a good frame for making a radical changes, to become widespread" Even if in the area of technological change economy, where the biological analogies are especially remarkable, they remain in the shadow of studies based on traditional economy theory. The evolutionist economic arguments built on biological analogies can be easily included, for example, in traditional "diffusion mechanisms" representing technological unbalance dynamic. The unsuccessfulness of biological analogies in creating an effect is not surprising, because the unique character of economic evolution lies in its being separate from biological evolution. This separation must be sought in the creative and cooperative dimensions of human behavior in economic area, not in competition

In spite of this kind of criticisms, in order to understand the interaction in terms of eco-innovations, using biological analysis, contribute to understand the processes better, as in the example of industrial symbiosis. What is important here is to define interaction better. Much as humankind made an effect on his/her lifestyle and his/her environment, as a result of this, the environment made an effect and made the sustainable development obligatory, solutions of sustainability will also have an effect on the environment. Hence, in terms of our word's survivability, this kind of selections can be observed to occur. The technological way dependency of evolutionist approaches makes very useful predictions in terms of analyzing the bifurcation and long termed effects of technological trajectories. For example, today, the fact that chemical industry is primarily based on carbohydrates is a technological dependency In order to break down this dependency, the strategies such as managing area of life gain importance. Here, another problem to be overcome is that in a certain technological advancement, the cost of making marginal change and cost of making radical change is very different from each other. When regarding to from this aspect, creating radical changes requires blending of very different policy instruments, long termed plan, and engagement of numerous counteragents to the policies.

In short, evolutionary approaches open the "black box" of surprises brought by radical changes. Considering the above explanations, evolutionary models for the establishment of environmental policies can contribute in three ways. First application, making a distinction between the effects on environment, innovation, and competition, is static and dynamic analysis of welfare effects of environmental analysis. The second area of application is about the analysis of conditions triggering the technological transition and is their interferences for public policies. Here, the role of diversity and flexibility, and life areas for infant technologies, and importance of protected environments are emphasized. Thirdly, evolutionist models are especially important for the analysis of the effects on, social dynamic, preference heterogeneity, and consumer demand in such a way that they can create opportunities for the frame of more developed models [16].

IV. Case Studies

In this study, as an example of managing area of life, case studies of wind energy innovation in Demark, of eco- parks, as an industrial organization innovation, and of automatic waste collecting systems, a sub-system innovation toward radical changes, were conducted. These are only several examples of a number of eco-innovations. Because they are an example of a tangible application, they make valuable predictions for both making policy and eco-innovation study. Especially, in terms of examining the evolutionist approaches, it can be said that they constitute good examples.

A. As Strategic Niche Management, Wind Energy Innovation in Denmark

Successfully developing the wind energy technologies in Denmark and Germany and that these technologies are adopted in the market are of successful innovations. Strategic niche management that can be understood as a result of the prediction of evolutionist economic approach about focusing on long termed problems, rather than short termed neoclassic approach, underlies this success. Strategic niche management is to create the protected areas for promising technologies. In the base of opinion, there is creating temporary pilot markets protected by subventions or other regulative actions. From this perspective, wind energy innovation in Germany and Denmark is a good example of the close cooperation between environmental and eco-innovation policies - for example, between economic incentives (subventions in Germany and energy tax in Denmark) and technology support programs [5].

Even if the idea of generating energy from wind emerged in Denmark in the late 19th century, two oil crises emerging in the years 1972 and 1979 orientated this country to invest on atomic energy and the other alternative energies. Since people of Denmark are against atomic energy, investment was made on wind energy as an alternative energy resource.

In the recent years, wind energy corresponds to 16 -19% of domestic production [17]. Denmark is in the first rank in the world in terms of its having the largest portfolio of wind energy project (21.6% in 2006) integrated to their own electricity networks and in terms of using total wind energy (3,136 MW), in 5th rank. In January 2005, 41% of energy use of West Denmark was obtained from wind energy. The country is undisputable leader of the world in terms of wind energy technology and in 2005, exported $ 7.45 billion of wind energy technology and equipment. While this total export amounts to 8% of total export of Denmark, it corresponds to one-third of total world export. Vestas, a Denmark company, 2533 wind turbine in 2006 and installs a wind turbine every five hours all over the world. In addition, Vestas installed 566 units of wind turbine far from seashore. Among R & D displacement and export, Denmark has the lowest energy consumption per capita in EU. While the main energy consumption was domestically increasing by only 4% between the years 1980 – 2004, and its economy recorded 64% of growth with constant prices [18]. The success of the underlying factors is discussed below

Denmark government played an active and supportive role in forming the capacity of wind energy.

Hence, in this achievement, in order to obtain technological change, broad policy instruments were used in both supply and demand parts. Although government has a great role, the fact that energy market In Denmark has a decentralized structure also has an important share in this achievement. The firms in the market of Denmark, such as Vestas, provided both clean energy and contributed to constituting of wind energy market with the clean energy polices they implemented. In order to constitute the wind energy market, the government carried out an active incentive policy and with 30% of investment subvention initiated to be implemented in the year 1979, supported the buyers of certified wind turbines. In spite of these financial benefits, in Demark, domestic market remained small and subvention was raised to 50%. These subventions were provided to individuals and cooperatives in the basis of dwelling criteria, not to suppliers. I.e. the individual and cooperatives became the owner of wind turbine. The people living in the distance of 3 km to a wind turbine were able to participate in the cooperative. Investment was exempted from the tax and extra electricity sale to network was also exempted from tax. One of the conditions of providing investment subventions is to subject to the type approval of Riso Test Central and thus a documentation system was realized. These documentation system encouraged quality in the stage of innovation. In addition, for placing the turbines more effectively, Denmark also published a wind atlas [19]. Together with these precautions, in 1981, an act on tariff guarantee stipulating that electricity facilities, in a given distribution area, must buy all energy generated from the renewable energy resource in rate of 70- 80 of consumer retail price, was accepted. In 1985, in the five years between the government and the electricity company a settlement agreement reached on the establishment of 100 MW capacities. These capacities were exactly reached in 1992 [18].

As a consequence of these polices, between the years 1984 and 1985, the capacity of wind energy increased four times. As the wind energy market develops and reaches a maturity, this direct investment subvention was decreases in stages and finally, in 1979, it was completely repealed. In addition to this, in order to develop domestic turbine production industry, custom tariffs were applied to import turbine components instead of turbine itself. Since this is trade restriction, according to WTO agreements, it is accepted that this is illegal [17].

Among the other actions taken, there are replacing the regional heating units with common heating units; forbidding the oil, diesel, and coal and instead of this, stipulating the use of natural gas; long termed financing guarantee for the big wind energy projects using the turbine made in Denmark; the right to access, open and guaranteed, to the network; sharing the network connection costs between the owner of wind turbine and electricity facility; and applying the general carbon tax on all energy forms [18]. Denmark wind energy innovation, in both diffusion and innovation stages, is one of the most remarkable examples of the achievement provided by combining a broad bundle of environmental and innovational policies and the experiences acquired in niche management.

B. Eco-Industrial Park Innovation as an Industrial Organization Innovation

Eco-industrial park innovation is a kind of industrial organization innovation. An eco-industrial park is an organization, where the business enterprises make cooperation to each other and local community, in order to increase the economic benefits and improve the environmental quality, for reducing waters and pollution; sharing the resources (information, material, water, energy, infrastructure, and natural resources) effectively; and providing the sustainable development. Cooperation strategies based on industrial ecology concepts can include not only by products but also water staging; logistic, sharing the shipping and acceptance facilities, park sharing, environmental clean technology buying blocks, multiplied environmental building modifications, regional energy systems, and local education and resource centers. This is an application of system approach, where a number of designs toward target, processes, and activities are integrated [20].

The main principle in industrial ecology, which industrial parks are based on, is to view the processes and industries as interacting systems, instead of viewing them as encompassing the isolated components in linear flow system. The comprehensive target of industrial ecology is forming an industrial system transporting almost all of materials it employed and releasing to the environment in minimum level of waste. These different waste producing systems provides a base to think of the ways of connecting the factories and industries to a network minimizing total amount of industrial material that goes to waste pool or is lost in intermediate processes. This is also the base of industrial symbiosis. This is also termed as closing the cycle [21].

One of the oldest and best known examples of eco-industrial parks is in Kalundborg, Denmark. Rather than being a result of process planned carefully, eco-industrial Park developed with the cooperation of several neighbor industrial companies incrementally. The main participative companies are a power central (Asnaesvaerket) operated by coal, an oil refinery (Statoil), a pharmaceutical and industrial enzyme plant (Novo Nordisk and Novozymes), a factory of plaster board (Gyproc), a soil improving company (AS Bioteknisk Jordrens), and Kalundborg Municipality via heating system of city. Eco–park, in order to take advantage from butane gas, which can take from Gyproc factory, Statoil Refinery, initiated to locate its pant, in Kalundborg, in 1970. This symbiosis also prevented from burning of Statoil butane gas to eliminate. Since that time, this network has grown and the participative companies are now in high level of integration. For example, waste heat of power central is used for heating 4500 private house and water of fish farm. The company Novo Nordisk supplies the extra yeast obtained from insulin production for farms as pigswill. Statoil refinery supplies the remaining pure liquid sulfur from desulphurization unit for a producer of sulfuric acid (Kemira). These exchanges are only one part of material flow, which totally amount to 2.9 million tons, including fuel gases, slime, fly ash, steam, water, sulfur, and gypsum. This industrial symbiosis largely enabled to be savings and reduced the environmental effects [12].

As can be seen from here, in such an eco-industrial park, waste of any plant can be used as an input for another plant and thus the environmental effect is r both educed and considerably amount of saving is provided from the resources.

According to literature review by Heeres et al. [22], in order to establish a successful eco-industrial park, it is necessary to install a business network in the base of both environmental and business performance. Also, in order to construct such an eco-park, it requires the shareholder to participate in actively. After ensuring the participation of shareholders, the first step to be taken in forming an industrial park is collecting information. Collecting information is to determine the exchanges between the organizations to be located in eco-park. One of the points necessary to be taken into consideration in a successful symbiosis is also that the local possibilities should be analyzed well, rather than imitating the other examples.

C. Innovation for Automated Vacuum Waste Collecting System

One of the innovations creating radical changes in sub – systems is also automated vacuum waste collecting system. Transporting the wastes, filled by pressurized gas into containers, through underground tunnel to a collection station underlies automated vacuum waste collecting system. When container is filled, it is transported an emptying place and emptied there. This system facilitates to separate and recycle the waste. System was first invented in Sweden and first located in Solleftea Hospital in 1961.

The first vacuum system for domestic wastes was first installed in the county of Ör-Hallonbergen, Sweden in 1965.

Envac AB (Sweden), inventor of system is still an important supplier. System is used in more than 30 countries. All over the world, it is estimated that approximately 1000 systems are located. In US, the systems in Disney World and Roosevelt Island are the best known ones. Barcelona, London, and Stockholm are among the major cities using the system. In Europe and North America, passing to the system, in a planned way, is foreseen. For example, Helsinki, Finland, vacuum system is planned to be located in the new Neighborhood Jätkäsaari. It is stipulated that all house cooperatives and the other apartment buildings should participate in network. The system foreseen for Lätkäsaari neighborhood will facilitate the separation and transformation of wastes. Each building for different waste types will be no more than five garbage pail or pipe. The waste is then collected in a storage point. Underground pipe work will work in similar way to a package keyed telecommunication network transporting a waste product in one time. After the input container is filled, it will be sent to central storage area in such a way that it is included in the same storage class [23].

One of the providers of this kind of systems is Stream AWCS solution presented by the company Sdn Bhd, of Malaysia This Company has a past of two decades. It markets centralized vacuum systems with the brand of STREAM.

The brand STREAM is one of the leading centralized vacuum technology providers of the world. One of the factors triggering for the company Nexaldes to develop the system

became bidding announcement of Singapore Interior Ministry associated with designing and supplying a centralized waste system [24]. The advantages of such a system are many more compared to traditional waste collecting system and, providing a new but partly solution for waste management, this eco-innovation can be characterized as a radical sub-system. Even if automated vacuum waste collecting system does not solve the problem of waste formation, it supports to collect wastes in environmentally suitable and safe, separate the wastes, and reuse them. In this process, producers, on the one hand contribute to the recycling of their products on the other hand play an important role in the product-life cycle. In order to develop receiving the waste and returning it to industrial and natural cycles, finally, in accordance with the principle of from cradle to cradle, they present opportunities. Furthermore, when this innovation is compared to instrument based waste collection; it forms the completely different technologies, specialism, and partnership [25]. For example, in case of STREAM, the bid of Singapore Government played an important role in developing project. That the system is a radical solution for waste collecting sub system can also be considered a way taken toward the change of system.

V. Conclusion

From now on, today, with the short termed approaches of traditional neoclassic economics, it can be said that there is a consensus in a considerable level in the literature about that the problem of sustainability cannot be overcome. In addition to the instruments neoclassic economics presented to us, with the prediction of evolutionist economic approaches, new opportunities emerge the solutions of sustainability.

With the prediction of evolutionist economic approaches, for understanding the locking effects of way dependencies, technological trajectories, and bifurcations and producing solutions to them, the case studies and ex-post analysis of niche managements gain importance.

In the frame of case studies presented above, it is seen that the common movement of different shareholders gains importance in both diffusion and innovation stages of eco-innovations. Among these shareholders, especially, the role of centralized government and local governments is great. As military projects played important role in technological developments such as internet, the niche managements, as governmental projects, will also have a large share in realizing the radical technological developments.

In a niche management, coordinating the innovation and environmental policies of government and developing the appropriate component of policy instruments appropriately, not focusing on a certain aim, are necessary. In terms of sustainable development in the future, the predictions the case studies focused on policy instrument gave will be important in success of eco-innovations.

In this area, both the instruments neoclassical economics presented and the studies, where the prediction of evolutionist approaches are used together i.e. which analyses the cooperation between the areas, will most shed light on this issue. The impact of the arrangements made here only on eco-innovation, but also the ecological impacts of eco-innovation should be taken into consideration.

Until recent time, eco- innovations are seen to be technological focused. Since this causes a phenomenon termed "technology prejudice", it leads to the social, organizational, and institutional eco-innovations to remain subsidiary. From this point of view, there is a need studies, where various classes and sorts of eco-innovations and their effect on each other are analyzed.

Another phenomenon, necessary to be considered here, is that eco – innovations emerge in several countries we calls a leader countries and then these eco –innovations become widespread. For example, wind energy technologies were invented and developed in Denmark and become widespread all over the world. Certainly, protective policies are also traced in forming local industry. From sustainability point of view, eco-innovations decrease the environmental burdens, but lead to emerging of a large local industry. As is the case in Denmark, some of the advantages of being a pioneer in eco-innovation should not be ignored. Hence, in terms of developing countries, becoming a county not only imitating but also producing eco-innovation gain importance. Therefore, it is necessary to become organized here for eco innovations, generally innovations. In this issue, although there are some suggestions, that innovations policies and environmental policies should be executed by a single ministry. This can be different from country to country. In success of eco –innovations, the social support and that the governments remain dependent on these policies to guarantee the success of eco- innovations are important.

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