CLEANTECH INNOVATION IMPLEMENTATION TOWARDS THE SUSTAINABLE DEVELOPMENT OF VIETNAMESE ENTERPRISES: CURRENT SITUATION AND RECOMMENDATIONS

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Abstract:

After decades of economic growth, partly at the expense of the environment, Vietnamese government is devoting closer attention to green solutions, among which Cleantech Innovation is emerging as a significant element. This paper aims to describe the general picture of the global Cleantech industry and illustrate the essential role of Cleantech Innovation in pursuing the sustainable development goals of Vietnamese government and enterprises. The paper suggests that Cleantech Innovation is an inevitable trend towards sustainable development and thus should be further promoted in Vietnam.

Keywords: *cleantech, cleantech innovation, sustainable development*

INTRODUCTION

Clean technology, or Cleantech, is an umbrella concept incorporating a diverse range of products, services, and processes that provide higher performance at a lower cost while minimizing adverse ecological impact and enhancing the responsible use of natural resources. Driven by fundamental trends in the global economy and society, among which are escalating natural resource costs, increasing internalization of externalities, growing consciousness on climate change and ecological degradation, many governments and enterprises throughout the world have directed assiduous attention to Cleantech Innovation is the key to offering competitive advantages while responding to energy and environmental challenges, thereby ensuring global sustainable development. Thus, in

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working towards the national goals of clean industrialization and sustainable development, Vietnamese government and enterprises should also lay special stress on further promoting and adopting clean technologies. With the aim of advocating this inevitable trend, this paper demonstrates the impressive growth of the global Cleantech industry and then validates the valuable role of Cleantech Innovation in pursuing sustainable development objectives.

1. CLEANTECH INNOVATION: THE STATE OF PLAY

1.1. Definitions of Cleantech and Cleantech Innovation

Clean technology, or Cleantech, does not refer to a particular industry sector, but is more of an umbrella concept used to describe a diverse range of products, services, and processes that eliminate or reduce adverse environmental impact. Cambridge Associates Limited Liability Company (Cambridge Associates LLC) includes companies and projects in the Cleantech sector if they "(1) develop non-fossil fuel energy sources, (2) promote industrial efficiency by conserving resources and replacing existing processes with less-polluting alternatives, (3) recycle waste effectively and efficiently, or (4) provide a product or service that creates an environmental improvement" (Cambridge Associates LLC, 2012). Table 1. shows the list of Cleantech sectors as reported by Kachan & Co. (2012). Within these sectors, renewable energy generation has received the most attention, and investments in wind, solar, and renewable fuels have been prominent (Kachan & Co., 2012).

Table 1. Eight categories of Cleantech

Renewable energy generation • Wind • Solar • Renewable fuels • Marine • Biomass • Geothermal • Fuel cells • Waste-to-energy • Nuclear • Emerging • Measurement & analytics	**Energy storage** • Batteries • Thermal storage • Mechanical storage • Super/ultracapacitors • Hydrogen storage	**Efficiency** • Smart grid • Green building • Cogeneration • Data centers & devices • Semiconductors • Collaborative consumption systems	**Transportation** • Vehicles • Traffic management • Fueling/charging infrastructure
Air & environment • Carbon sequestration • Carbon trading/offsets • Emission control • Bioremediation • Recycling & waste • Monitoring & compliance	**Clean industry** • Materials innovation • Design innovation • Equipment innovation • Production • Monitoring & compliance • Advanced packaging	**Water** • Production • Treatment • Transmission • Efficiency • Monitoring & compliance	**Agriculture** • Crop farming • Controlled environment agriculture • Sustainable forestry • Animal farming, CAFOs • Aquaculture

Source: Kachan & Co, 2012

According to the Cleantech Group, Cleantech should not be confused with the term Greentech popularized in the 1970s. While green technologies offer limited opportunity for attractive returns, clean technologies "provide superior performance at lower costs, while greatly reducing or eliminating negative ecological impact, at the same time as improving the productive and responsible use of natural resources" (Cleantech Group, 2012).

Cleantech Innovation, as a subset of sustainable innovation, can be defined as "development of technologies in physical, chemical, biological sciences that enable more efficient, productive and valuable use of, and greatly reduced impact on, natural and other scarce resources as compared to what is commercially available today" (Steen & Frankel, 2003).

1.2. The global trend of Cleantech Innovation

The global economy is undergoing a profound transformation, in which enterprises are facing growing pressure to produce and consume with increased efficiency and enhanced sustainability. This pressure has really opened doors for Cleantech Innovation. Analyzing the pressure, Pernick and Wilder (2007) identify six drivers of cleantech growth, which they call the six C's: Costs, Capital, Competition, China, Consumers, and Climate:

- Costs: "Perhaps the most powerful force driving today's clean-tech growth is simple economics. As a general trend, clean-energy costs are falling as the costs of fossil fuel energy are going up. The future of clean tech is going to be, in many ways, about scaling up manufacturing and driving down costs."

- Capital: "An unprecedented influx of capital is changing the clean tech landscape, with billions of dollars, euros, yen, and yuan pouring in from a myriad of public and private sector sources."

- Competition: "Governments are competing aggressively in the high stakes race to dominate in the clean-tech sector and build the jobs of the future."

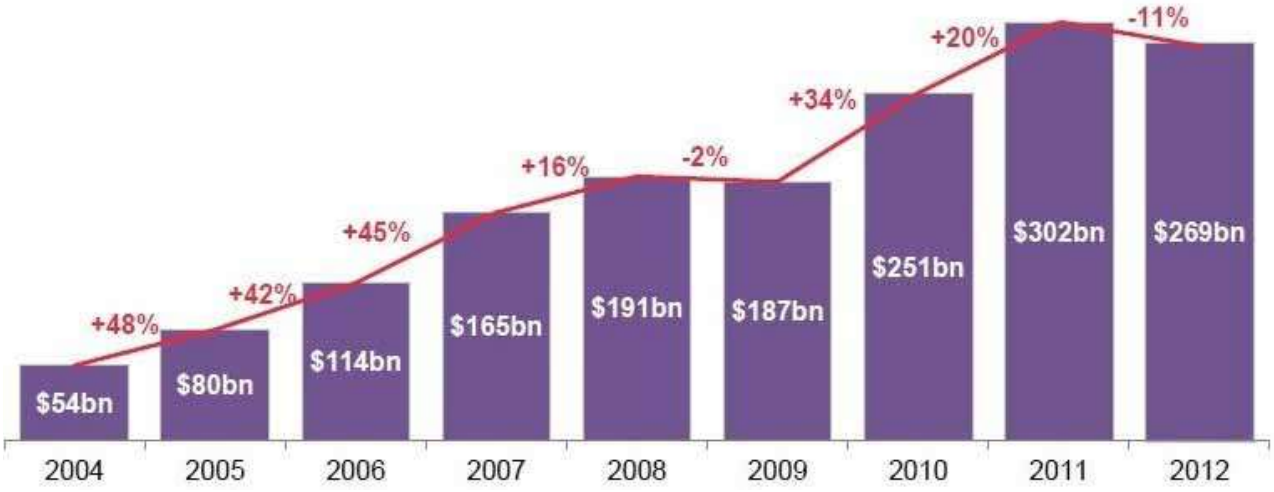
- China: "Clean tech is being driven by the inexorable demands being placed on the earth not only by mature economies but also by the explosive demand for resources in China, India, and other developing nations. Their expanding energy needs are driving major growth in clean-energy, transportation, building, and water-delivery technologies."

- Consumers: "Savvy consumers are demanding cleaner products and services that use resources efficiently, reduce costs, and embrace quality over quantity."

- Climate: "The debate around climate change has gone from question mark to peer-reviewed certainty, and smart businesses are taking heed".

Consequently, after a decade in development, Cleantech is now moving steadily into mainstream business and poised for even more rapid growth. According to Bloomberg New Energy Finance, global investment in cleantech energy was estimated to be $269 billion in 2012, 230 percent higher than in 2005 (see Figure 1). Better yet, according to Grant Thornton International, the global business for Cleantech energy will be as big as $349.2 billion in 2020 (Grant Thornton International, 2011).

Figure 1. Global total new investment in clean energy 2004-2012 ($BN)



Source: Bloomberg New Energy Finance, 2012

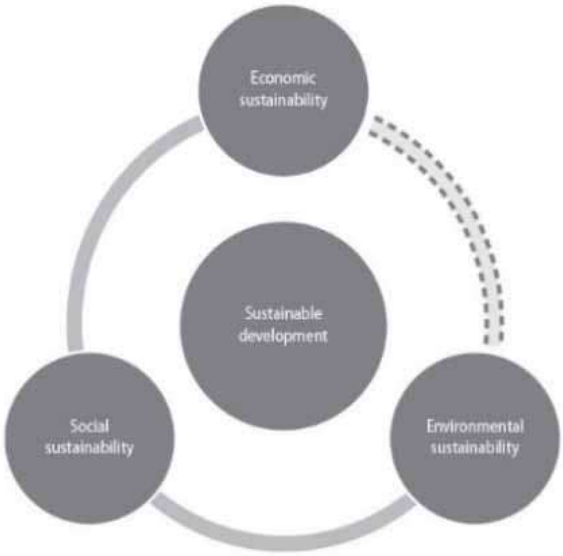
Note: Includes corporate and government R&D, and small distributed capacity. Adjusted for reinvested equity. Does not include proceeds from acquisition transactions.

Having transitioned through a period of overhyped expectations, Cleantech is at an exciting time in its evolution to mass market adoption. In Moore's revised technology adoption lifecycle model, most Cleantech companies are at the chasm, or the market gap between early adopters, who are motivated to purchase latest technologies for competitive benefit, and the majority of consumers, who prefer to purchase established technology (Moore, G., 2006). Only the companies nimble enough to cross the chasm are successful (Kachan, D., Fugere, D., 2013).

1.3. Cleantech Innovation as a catalyst for the sustainable development of enterprises

Involving concepts of qualitative and quantitative changes, sustainable development can constitute primarily social, environmental, or economic development (Scottish Environment LINK, 2009). The relationship among these three pillars of sustainable development is shown in Figure 2.

Figure 2.The three pillars of sustainable development



Source: World Bank, 2012

Notably, the two pairs of relationship between economic and social sustainability and social and environmental sustainability have been found to be not only compatible, but also mainly complementary. This has not

been the case for economic and environmental sustainability since economic growth has come largely at the expense of the environment, hence the dotted line on Figure 2 and that is where green growth comes in to enhance the compatibility of economic and environmental sustainability (World Bank, 2012).

Thus, Cleantech Innovation–as a catalyst for green growth–serves to bridge the gap between economic and environmental sustainability, thereby supports the sustainable development goals of enterprises. For example, enterprises that make strategic investments in internal research and development, joint ventures and acquisitions of companies that use disruptive technology (advances that improve a product or service in ways that are unexpected by the market) are creating both effective, innovative Cleantech solutions and value in their operations (Adriaens, 2010). The rationale is that Cleantech investments help resolve the potential impacts of climate change and resource depletion on the long-term growth strategies and thus market valuations of enterprises. Since 2004, disclosures in the financial market of economic, environmental, and social performance have become increasingly common in enterprises' financial reporting and are crucial for organizational success.

Since 2000, the Dow Jones Sustainability Indexes (DJSI) have tracked the financial performance of sustainability-driven enterprises around the world, and many organizations have analyzed sustainability indicators (RiskMetrics Group, & Ceres., 2008). However, as sustainability is becoming a driver for corporate strategy and differentiation, enterprises will need next-generation practices that change the existing business paradigms. Enterprises' actions should involve in changing pay reward structures, governance systems, and supply chain management; setting renewable energy purchasing targets; and strategically investing in disruptive technologies. Cleantech allows businesses to adjust the way they operate in that technology differentiation results in strategic differentiation from the competition within and outside their industry sectors.

Many enterprises have paid closer attention to the large portion of carbon and water footprints in their supply chains. A number of leading enterprises has begun to manage their risks and develop emission measurement standards, thereby identifying appropriate types of CleanTech investments technologies that offer solutions for greening their operations (Adriaens, 2010).These enterprises are especially concentrating on the early stages in the value chain, which allows them to break into new markets while integrating the innovations into their operations and supply chains (Adriaens, 2010).Since it is difficult to measure and control greenhouse gas emissions from raw materials processing, component suppliers, and the transportation of goods, these sites must collaborate with one another and with suppliers.

2. THE IMPACT OF CLEANTECH INNOVATION ON THE SUSTAINABLE DEVELOPMENT OF VIETNAMESE ENTERPRISES

2.1. The context of energy consumption in Vietnam

Since its economic reform in 1986, Vietnam has been the second fastest-growing economy

in Asia with the compound annual growth rate of 5.3% in 1986–2010 (McKinsey Global Institute, 2012). This nation of 91 million people achieved the middle-income status in 2009 with the GDP per capita of $1,160 and is aiming to become a fully industrialized country by 2020 (Welle-Strand, A., 2013). The rapid growth has led to ever-increasing energy consumption, forcing structural shifts in Vietnam's energy supply.

Vietnam's energy consumption has been increasing faster than GDP in the past 10 years, averaging about 13% per year (APERC Energy Overview, 2008). The commercial energy use per GDP growth elasticity registered very high owning to a fast expansion of heavy industries and increased use of fossil fuels for power generation. Unlike the past decade, however, meeting this demand through a doubling in energy supply in the coming decade could be a far more serious challenge since much more of the supply required may need to be imported, meaning skyrocketing costs. Nearly one-quarter of Vietnam's domestic energy consumption comes from oil, with **hydropower** (10 percent), **coal** (20 percent), and natural gas (11 percent) supplying the remainder. As the country continues industrializing and installing greater power capacity, Vietnam is seeking to develop all its natural resources (Energy profile of Vietnam, 2013). According to "Vietnam National Energy Development Strategy up to 2020 and vision to 2050", energy consumption should increase by an average of 7%/ year until 2020. In 2020, the share of coal should drop to 15%, and the share of gas should increase to 29%, while the share of oil is expected to be 56%. Vietnam indeed needs to invest in energy efficiency to meet the growing power demands and to ensure a sustainable economic growth.

2.2. Current situation of implementing cleantech in Vietnam

This study considers some priority areas for sustainable development of Vietnamese enterprises, namely (i) Maintaining rapid and sustainable growth rate; (2) Switching to environmentally-friendly production and consumption models; (3) Implementing the "clean industrialization" process; (4) Ensuring sustainable development of regions and localities; (5) Protecting water bodies and using water resources in a sustainable manner; (6) Ensuring rational exploitation and sustainable use of mineral resources; (7) Reducing air pollution in urban and industrial zones; and (8) Managing solid waste and hazardous waste.

One of the major challenges for almost every Vietnamese enterprise is the lack of access to energy efficiency technologies and practices, resulting in low manufacturing productivity, natural resource depletion, and environmental pollution. In order to address the root causes of pollution and ensure the sustainable development of Vietnamese enterprises, the Government has provided the enterprises with immediate solutions for enhancing resource efficiency and reducing greenhouse gas emissions. Among these solutions, Cleantech innovation is proving to be a viable solution to both objectives.

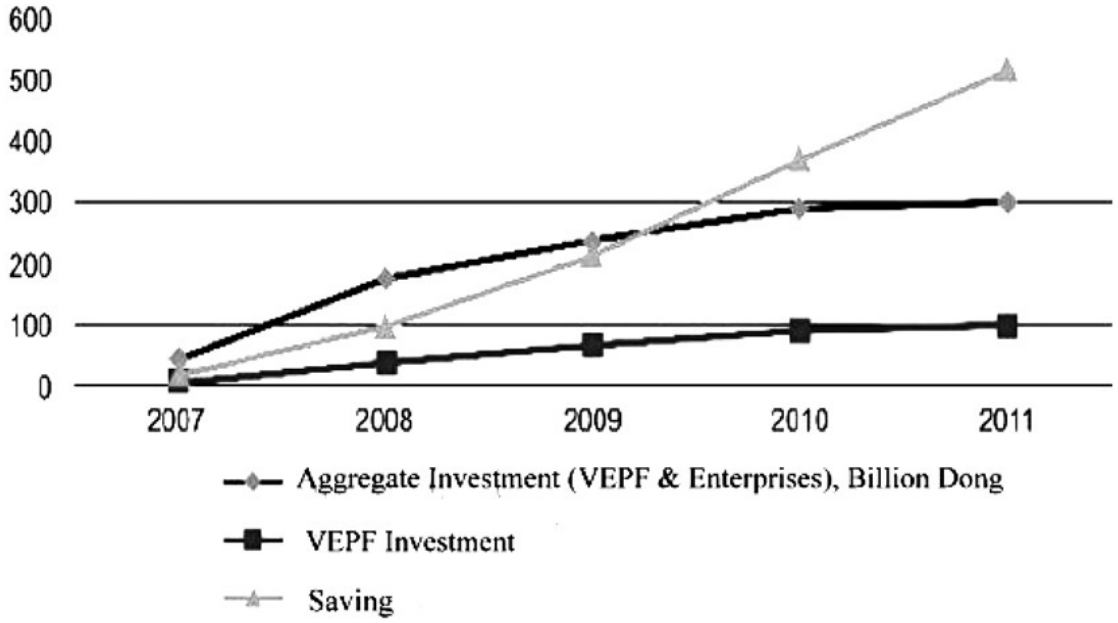
Cleaner Production in Industry Component

Cleaner Production was officially introduced in Vietnam by the Ministry

of Industry and Trade within the Cleaner Production in Industry Component (CPI) in 1996 (UNDP, 2012). In recent years, the Government has promulgated many Cleantech promotion policies aimed at improving energy and resource efficiency and controlling environmental degradation. For instance, the Law on Efficient Use of Energy was passed by the National Assembly in 2010 and the National Green Growth Strategy was approved in 2012. The Government has also provided several financial mechanisms for encouraging the efficient use of energy and natural resources. Case in point, the Vietnam Environment Protection Fund (VEPF)–a State-run financial organization–was launched with the aim of offering financial support to nature conservation projects and especially enterprises adopting clean technologies. VEPF has provided financial support to 139 enterprises, of which 63 are pursuing cleaner production. (Ministry of Industry and Trade, 2011). This financial support has produced positive financial results, as shown in Figure 3. According to this multiple-line graph, the investment in cleaner production of the Vietnamese enterprises supported by VEPF has reaped substantial economic benefits since 2009, two years after the project launch.

Notably, the National Target Program on Energy Efficiency for the period 2006-2015 has been implemented with many remarkable efforts to promote Cleantech, among which are the establishment of the network of energy efficiency initiatives in central provinces and cities, the advocacy of energy efficiency and environmental protection, the installation of new energy efficiency equipment, to mention but a few. As a promising result, during Phase I (2006-2010) of the Program, about 150

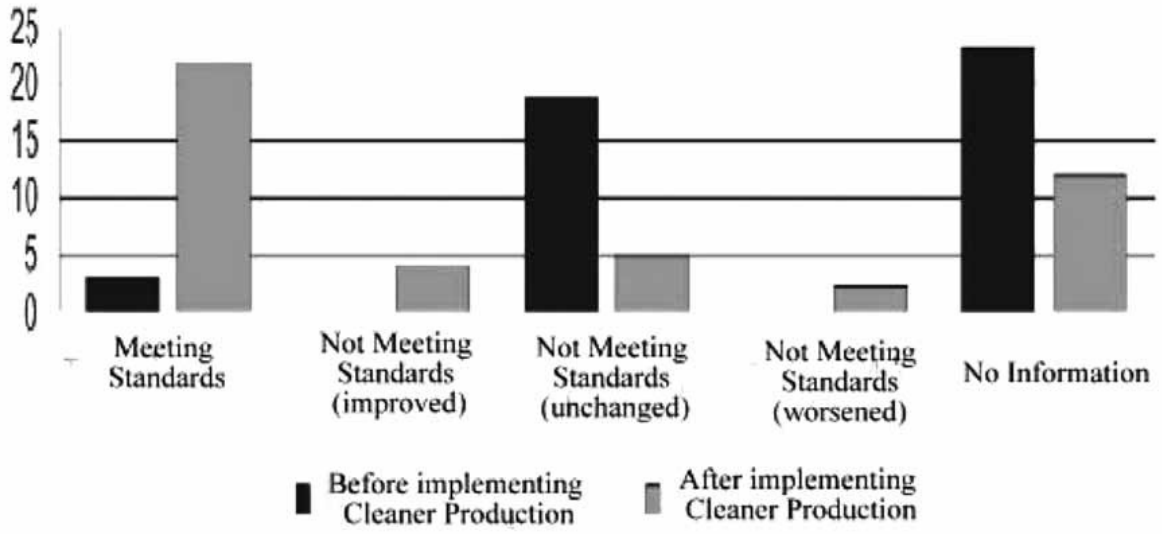
Figure 3. Comparison between investment amounts and economic benefits gained throughout the project



Source: Ministry of Industry and Trade, 2012

proposals and projects have been launched with a saving of 4900 KgOE, which equals 3.4% of the national aggregate energy consumption (Ministry of Industry and Trade, 2011). Simultaneously, a "clean industrialization" process, as part of the National Strategy on Cleaner Production in Industry up to 2020, is also taking place as a move towards greater integration between industrial development and eco-friendly principles. The program has witnessed an impressive growth of roughly 700% in the number of Vietnamese enterprises achieving emission standards, as illustrated in Figure 4.

Figure 4. Number of enterprises meeting environmental emission standards



Source: Ministry of Industry and Trade, 2012

The National Strategy on Cleaner Production in Industry Program carried out cleaner production demonstration in 61 enterprises, more than the initially planned number. The Program was more successful than expected in communications activities and replicating cleaner production models to non-target provinces. With support from the National Strategy on Cleaner Production in Industry, the enterprises conducted a review of all their production processes and found out solutions that should be implemented immediately. Cleaner production not only helped enterprises save energy and materials and increase production, but also improved product quality and enhanced the company's reputation.

In addition to the Program launched by the Ministry of Industry and Trade, many other energy efficiency promotion programs have also been set up with the support of international organizations. These programs have made significant contributions to the more efficient use of energy and natural resources in Viet Nam's industrial production (UNDP, 2012).

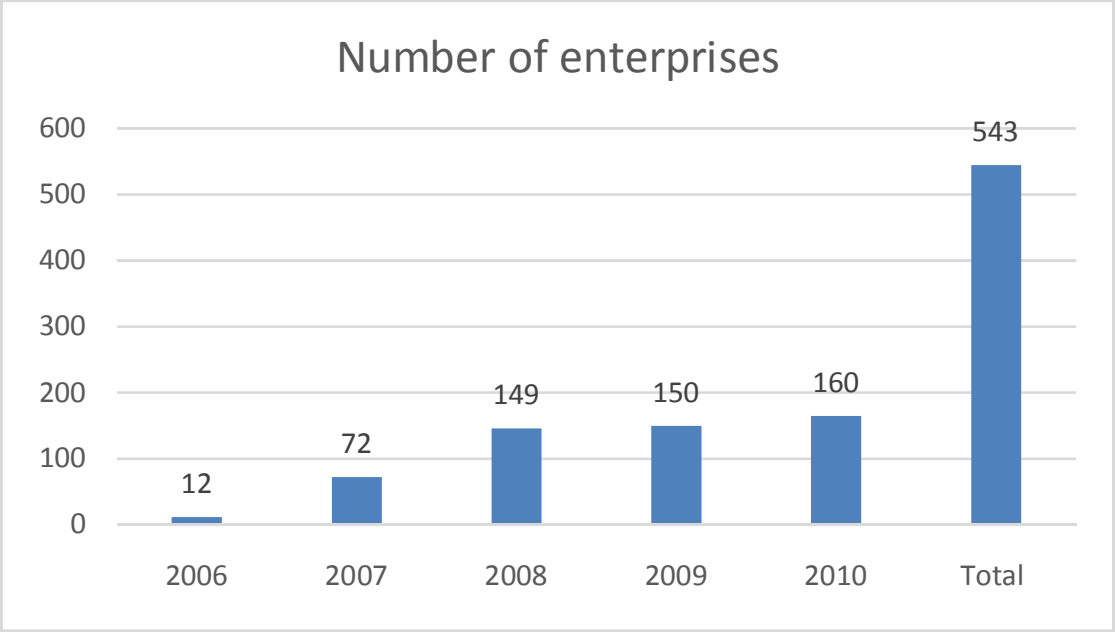
Cleantech Innovation in Small and Medium-sized Enterprises

Promoting Cleantech by improving energy efficiency in production poses a radical challenge for all Vietnamese enterprises, especially small and medium-sized enterprises (SMEs), which suffer from low productivity

and competitiveness due to high fuel and material costs as well as poor access to technology and management expertise.

The Ministry of Science and Technology has promoted a national project named "Promoting Energy Conservation in Small and Medium-sized Enterprises in Viet Nam" (PECSME) for the 2006-2010 period in order to reduce greenhouse gas emissions by removing the barriers to extensive transfer and adoption energy efficiency technologies and practices of SMEs in Viet Nam (UNDP, 2012). By June 2011, 545 projects on energy efficiency have been completed, and 25 provinces and cities have been supported to adopt energy efficiency initiatives, of which 12 provinces and cities have formulated policies and institutions to assist SMEs. Figure 5 demonstrated an ever-increasing tendency in the number of Vietnamese SMEs adopting energy efficiency solutions in the 2006-2010 period.

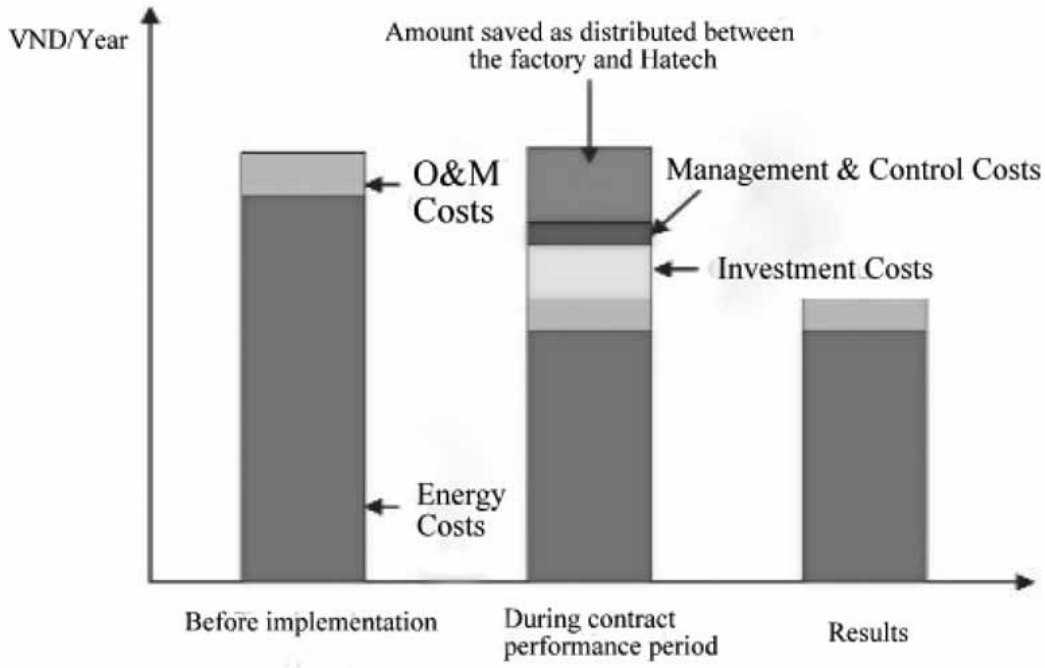
Figure 5. Number of enterprises implementing energy efficiency solutions during 2006-2010



Source: Ministry of Science and Technology, 2011

Thanks to the project, 25 energy efficiency service providers have assisted over 500 SMEs, showing promising results. For example, 232,000 tonnes of oil equivalent has been saved, 944,000 tonnes of Carbon Dioxide has been reduced, and energy costs have been lowered by 24.3 percent. Better yet, the SMEs has seen their efforts being paid off with roughly 10-50% reduction in production costs, 30% increase in productivity and product quality, suggesting a significant improvement in competitiveness and sustainable development (Ministry of Industry and Trade, 2011). As a case in point, Figure 2.4 illustrated the success of the cooperation between Vietnamese SMEs and Hatech Energy Corporation, one energy efficiency service provider in the project.

Figure 6. Benefits and costs of enterprises before and after adopting cleaner production



Source: Ministry of Science and Technology, 2011

Note: O&M Costs stands for Operations & Maintenance Costs

The outcomes of Cleantech innovation in industrial enterprises points out not only economic benefits–the top priority of most enterprises–but also environmental benefits. Indeed, Cleantech innovation offers a win-win solution to the industrialization, modernization, and sustainable development objectives. The technical solutions proposed are suitable for Vietnamese enterprises in that the technologies involved are reasonably affordable and not too complicated.

3. RECOMMENDATIONS

Cleantech Innovation has made substantial contributions to the sustainable development of Vietnamese enterprises. To expand and replicate these practices and initiatives, it is recommended that Vietnam:

● Introduce mechanisms and incentives for the implementation of Cleantech Innovation activities, models and initiatives. For example, incentives such as lower taxes or renewable obligation certificates have been applied in Europe and the United States.

● Increase financial support from the State budget allocation to Cleantech Innovation activities, initiatives and models. For example, governmental grant funding is commonly available for the Cleantech sector in Europe and the United States.

● Promote the use of Cleantech venture capital, the new category of venture investing that has been promoted by the Cleantech Group with the aim of transforming thinking about the economic potential of combining the venture investment model with technical solutions to emerging energy and resource

challenges. For example, the top venture capital firms in the world such as Kleiner, Perkins, and Caufield have raised large funds for Cleantech investments. Thanks to that, global investment in Cleantech ventures has been soaring in the last decade from less than $1 billion in 2000 to over $3.5 billion in 2010 (Nordan, M., 2011).

● Promote the participation of stakeholders, especially scientists, NGOs, and social organizations in implementing the clean technology activities, models and initiatives;

● Increase international cooperation to share experience in developing and implementing clean technology activities, models and initiatives, and call for support from the international community in implementing and replicating clean technology models and initiatives.

4. CONCLUSION

The trend of adopting Cleantech innovation as a sustainable practice in Vietnamese enterprises is an inevitable and growing trend towards enhancing the enterprises' competitiveness by delivering stronger performance at lower production costs while minimizing adverse environmental impact as well as enhancing the responsible use of natural resources in Vietnam. Effective Cleantech innovation practices towards sustainable development can be analyzed and utilized for industrial production and business services in various sectors and on different scales. Nonetheless, major constraints in terms of technologies, financial resources, and human resources remain serious obstacles for Vietnamese enterprises in employing these sustainable practices. Thus, for the extensive application of Cleantech innovation to be successful, it is crucial that Vietnamese government should offer financial incentives and provide technical support and information to enterprises that run or make investments in environmentally-friendly projects. Furthermore, Vietnamese enterprises should acquire a profound understanding of the advantages of cleaner production and display a strong commitment from senior management.❑

References

1. Adriaens, P. (2010), 'Investment, Cleantech', Ross School of Business, University of Michigan
2. Cambridge Associates LLC (2012), Clean Tech Company Performance Statistics: Cambridge Associates LLC.
3. Cleantech Group (2012), What is Cleantech?. Retrieved from http://www.cleantech.com/about-cleantech-group/what-is-cleantech/
4. Climate Investment Fund (2009), Clean Technology Fund Investment Plan for Vietnam, Intersessional Meeting of the CTF Trust Fund Committee Washington, D.C. December 1-2, 2009
5. The Vietnam Prime Minister, Decision No. 1855/QĐ-TTg, dated December 27th, 2007 on Vietnam National Energy Development Strategy up to 2020 and vision to 2050

6. Energy profile of Vietnam (2013), Retrieved from: http://www.eoearth.org/view/article/152542
7. Fay, M. et al (2012), "Inclusive Green Growth The Pathway to Sustainable Development", World Bank Report p.2
8. Grant Thornton International (2011), Clean Tech on the rise: Grant Thornton International.
9. Kachan, D., Fugere, D. (2013). CleanTech redefined: Kachan& Co.
10. Kachan& Co. (2012), Two years later: Revisiting the taxonomy of cleantech. Retrieved from http://www.kachan.com/content/two-years-later-revisiting-taxonomy-cleantech
11. Lim, V. (2012). Vietnam notes renewable energy sites. Retrieved from http://asian-power.com/environment/news/vietnam-notes-renewable-energy-sites
12. McKinsey Global Institute (2012), Sustaining Vietnam's growth - The productivity challenge: McKinsey Global Institute.
13. Ministry of Industry and Trade (2011), Review report on phase I (2006 - 2010) and orientation for implementation agenda for phase II (2011 - 2015) of the National Target Program on efficient and economical energy use. The National Steering Committee for Efficient and Economical Use of Energy. Ha Noi, 1 March 2011.
14. Ministry of Science and Technology (2011), Brochure for seminar "Promting Energy Conservation in the Small and Medium sized Enterprises of Viet Nam" (PECSME) for 2006-2010 period. Ha Noi.
15. Moore, G. (2006). Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers: HarperBusiness.
16. Nordan, M. (2011), The state of Cleantech venture capital. Retrieved from http://gigaom.com/2011/11/28/the-state-of-cleantech-venture-capital-part-1-the-money/
17. Pernick, R., Wilder, C. (2007), The Clean Tech Revolution: The Next Big Growth and Investment Opportunity: HarperBusiness.
18. RiskMetricsGroup,& Ceres. (2008), Corporate governance and climate change: Consumer and technology companies. Retrieved November 16, 2009
19. Scottish Environment LINK (2009), Living with the Land, Proposals for Scotland's First Sustainable Land Use Strategy, Published by Scottish Environment LINK, 2009, 2 Grosvenor House, Shore Road, Perth PH2 8BD www.scotlink.org
20. Steen, J., Frankel, P. (2003), The Flow of Venture Capital into Clean Technology: The Center for the Study of Fiduciary Capitalism.
21. UNDP (2012), Vietnam: Some good Sustainable Development Practices, Report at the United Nations Conference on Sustainable Development (Rio+20)
22. Welle-Strand, A., Vlaicu, M., Tjeldvoll, A. (2013), Vietnam – A New Economic Dragon in Southeast Asia?: Journal of Developing Societies.