Alternatives to Private Finance: Role of Fiscal Policy Reforms and Energy Taxation in Development of Renewable Energy Projects

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Alternatives to Private Finance: Role of Fiscal Policy Reforms and Energy Taxation in Development of Renewable Energy Projects

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Abstract The main obstacle to the development of Renewable Energy (RE) projects is lack of access to finance. Electricity tariff is often regulated by the government, hence, to increase the investment incentives the spill over effects originally created by energy supplies need to be used. Tax revenues are refunded to the investors in energy projects and such fiscal policy reform will increase the rate of return of energy projects. For smaller-size energy projects, this chapter provides a theoretical model for combining utilisation of carbon tax and a new way of financing risky capital, i.e., Hometown Investment Trust Funds (HITs). Because of the Basel capital requirement, and because most RE projects from the point of view of financers are considered to be risky projects, and thus many financers are reluctant to lend to them or they lend at high interest rates. This chapter theoretically shows that by taxing carbon dioxide (CO_2), sulphur dioxide (SO_2), and nitrogen oxides (NO_x) and allocating those tax revenues to HITs, RE projects will become more feasible and more interesting for hometown investors, hence the supply of investment money to these funds will increase.

Keywords Carbon tax · Renewable energy · Hometown investment trust funds

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1 Introduction

Asia has driven the increasing trend in world energy consumption in the last 2 decades. In 2016 the Asia Pacific region consumed, 5,580 Million tonnes oil equivalent (Mtoe) of Primary energy or 42% of the global primary energy consumption. In 2016 the region experienced 2.1% growth rate from 2015, while global primary energy consumption growth rate was 1% and total Europe and Eurasia experienced just 0.4% growth rate (BP 2017). Fossil fuels, especially coal, are the main sources of fuel for the Asian economies; their greater reliance on fossil fuels has made climate issues and global warming a serious matter. Most climate scientists agree that the main cause of the current global warming trend is human aggravation of the "greenhouse effect" from fossil fuel warming that is a consequence of the atmosphere trapping heat radiating from Earth toward space. In 2016, carbon dioxide emissions of the Asia Pacific was 16,101 million tonnes of carbon dioxide or 48.2% of the Total world carbon dioxide emissions (BP 2017)[1]. In this circumstance, RE projects would be a sustainable solution for mitigating the climate issues from the current serious level.

The climate change and global warming that are mainly caused by greenhouse gas (GHG) emissions is beyond the "point of no return" that merit government intervention and reforms through different ways such as fiscal reforms and carbon taxes to reduce level of pollutions.

Without government intervention, there is no market incentive for firms and households to take into account environmental damage, since its impact is spread across many people and it has little or no direct cost to the polluter. Therefore, protection of the environment generally requires collective action, usually led by government.

In the past, environmental policy was typically dominated by "command-and-control" regulations. These approaches were generally prescriptive and highly targeted—e.g. banning or limiting particular substances or requiring certain industries to use specific technologies. Over recent decades, interest has grown in using market-based instruments such as taxes and tradable emission permits. There are a number of reasons for the increasing use of environmental taxes (OECD 2011).

Apart from the environmental reasons, another reason for development of RE projects is raising energy self-sufficiency[2] and energy security by diversification of energy resources. Too much reliance on limited resources of energy (such as coal, oil, or gas) will reduce the resiliency of the economy and make it more prone to

[1]The carbon emissions above reflect only those through consumption of oil, gas and coal for combustion related activities, and are based on 'Default CO_2 Emissions Factors for Combustion' listed by the IPCC in its Guidelines for National Greenhouse Gas Inventories (2006). This does not allow for any carbon that is sequestered, for other sources of carbon emissions, or for emissions of other greenhouse gases. This data is therefore not comparable to official national emissions data.

[2]Domestic production of primary energy (including nuclear)/domestic supply of primary energy $\times$ 100 (Yoshino et al. 2017).

energy price fluctuations. Several studies (see, inter alia, Hamilton 1983; Barsky and Killian 2004; Taghizadeh-Hesary et al. 2013, 2016; Taghizadeh-Hesary and Yoshino 2016) have evaluated the impacts of oil price fluctuations on various macroeconomic indicators and generally found that oil shocks are disruptive to economic growth and create inflation for most oil-importing countries.

In a more recent study Taghizadeh-Hesary et al. (2017) showed that after the Fukushima nuclear disaster in March 2011, which resulted in the shutting down of nuclear plants and the substitution of nuclear power with fossil fuels, energy security in Japan was suffered. The authors applied a co-integration analysis and performed a vector error correction (VEC) variance decomposition by using quarterly data from Q1 1981 to Q4 2010 and from Q1 2011 to Q4 2015. Their findings reveal that the absolute value of elasticities of oil consumption in some economic sectors decreased after the disaster because of an increased dependency on oil consumption, which endangered the country's energy security. They suggested that to raise energy self-dependency and energy security, Japan needs to diversify its energy supplies.

As a result of eliminating nuclear power generation and substituting it with fossil fuels energy self-sufficiency fell from 19.6% in fiscal year 2000 to 8.6% in fiscal year 2013 (MIAC 2015). Before the 2011 earthquake, Japan was the third largest consumer of nuclear power in the world, after the United States and France. In 2010, nuclear power accounted for about 13% of Japan's total energy supply (Taghizadeh-Hesary et al. 2016). In 2012, the nuclear energy share fell to 1% of total energy supply and contributed at a similar level to primary energy consumption in 2013 as only two reactors were operating for a little more than half the year. In 2014, Japan did not produce any nuclear power (Taghizadeh-Hesary and Yoshino 2015).

Hence, increasing the share of RE resources in the energy basket is required. One of the obstacles to development of RE projects is lack of access to cheap finance. Easing finance for investment in green and low-carbon energy projects is a key challenge for climate change mitigation (Dangerman and Schellnhuber 2013; Grubb 2014; Stern 2015).

In recent years, several new methods for financing low-carbon energy projects have been developed, including green bonds, green banks, village funds, etc. Green banks and green bonds partially have the potential to help clean energy financing. The advantages of green banks include improved credit conditions for clean energy projects, aggregation of small projects to reach a commercially attractive scale, creation of innovative financial products, and market expansion through dissemination of information about the benefits of clean energy. Supporters of green bonds believe that it can provide long-term and reasonably priced capital to refinance a project once it has passed through the construction phase and is operating successfully (NRDC 2016).

Although the aforementioned methods were somehow helpful for development of low-carbon/green projects the data suggests they are inadequate. Fossil fuel investments continue to be much larger than investments in RE. In 2013, RE received investments of only about US$260 billion, which is only 16% of the

US$1.6 trillion in total energy sector investments (IEA 2014). Meanwhile, investment in fossil fuels in the power sector, where they compete directly with electricity from RE, rose by 7% from 2013 to 2014 (UNEP and BNEF 2015). Most recently, The Asia Pacific became pioneer in the field of new investments in RE projects. In 2016, share of the region in the total world RE consumption[3] was 34.4%, in the same year share of North America, South and Central America, Europe and Eurasia, Middle east and Africa were 23.1%, 6.7%, 34.3%, 0.2% and 1.2%. In 2016, annual growth rate of consumption of RE in the Asia Pacific from was 27.9% (BP 2017). However, clearly fossil fuels still dominate energy investments. A major concern in the transition to low-carbon energy provision, therefore, is how to obtain sufficient finance to steer investments toward RE (Mazzucatoa and Semieniukb 2017).

Due to the limitations of the Basel capital requirements on lending by financial institutions, and because banks consider most RE projects to be risky, banks are reluctant to finance them. Hence, relying on banking finance is not a solution for financing green energy projects and we need to look for new channels of financing this sector to fill the financing gap for such projects. Bank lending has to be allocated to safer sectors and businesses.

This chapter is providing two types of financing solutions for energy projects based on the project scale: (i) larger RE projects (e.g., large hydropower projects), (ii) smaller-scale RE projects. For the first group this chapter will provide practical solutions and then focus more on the theoretical and practical aspects of financial solutions for smaller RE projects, e.g., solar energy projects or wind power projects. This chapter will highlight that the proposed method is the joint utilization of fiscal policy (carbon tax) and Hometown Investment Trust (HIT) funds, which can increase the supply of fund to these projects (see Yoshino and Kaji 2013; Yoshino and Taghizadeh-Hesary 2014a).

This chapter is structured as follows. In Sect. 2 we first provide an overview of energy demand in Asia for both fossil fuels and RE projects. Section 3 provides a solution for financing larger green energy projects. Section 4 focuses on the theoretical model for financing smaller RE projects (i.e., solar and wind). The last section provides concluding remarks.

2 An Overview of Energy Demand in Asia

Worldwide demand for energy has reached unprecedented levels that change the energy landscape. Nowhere is the growth of energy demand higher than in Asia, and the region is set to surpass the rest of the world in terms of energy consumption before 2035. Much of this demand is met through conventional fossil fuel sources, which increase Asia's GHG emissions and contribute to climate change. Alongside

[3]Based on gross generation from renewable sources including wind, geothermal, solar, biomass and waste, and not accounting for cross-border electricity supply.

this, Asia is home to the largest number of people without access to modern energy, with 600 million without access to electricity, and 1.8 billion without access to modern fuels. Generally, Asia draws its energy from conventional fossil fuels (e.g., oil, coal, and natural gas) and naturally RE resources (e.g., hydro and geothermal power) (ADB 2015).

The Asia Pacific region accounts for around 42% of world primary energy consumption[4] in 2016 (BP 2017), larger than OECD. In a business-as-usual scenario, the region's total primary energy demand will increase steadily, from 4,985.2 Mtoe in 2010 to 8,358.3 Mtoe in 2035 (i.e., by 2.1% per year), which is the fastest rate of growth in demand worldwide. Asia has driven the increasing trend in world energy consumption over the last 2 decades. In 2016, the growth rate for the Asia Pacific primary energy consumption was about 2.1% compared with 1% worldwide (BP 2017).

Below we highlight energy demand in the Asia and the Pacific region for each energy carrier among fossil fuels and RE categories.

2.1 Fossil Fuel

Coal

In 1994, 40.5% of the Asia Pacific region's energy needs were fuelled by coal (ADB 2013); by 2016 this had risen to 49.35% (BP 2017). Since the beginning of the 21st century, coal has been the fastest-growing energy source worldwide. The Asia Pacific is the biggest market for coal worldwide, in 2016 accounts for 73.80% of global coal consumption. The region had 46.5% of the world's total proved coal reserves[5] at the end 2016. In 2016, coal production totalled 3,656.4 Mtoe worldwide, a 6.2% decrease over 2015. Table 1 shows top 10 coal-producing countries and their production in 2016.

Because coal is a finite source of energy, sustainability is a key issue in its production. Global reserves of coal at the end of 2016 was 1,139 billion tons. Coal consumption causes serious environmental issues such as greenhouse gas (GHG) emissions, which contribute to global warming, acid rain, and localized air pollution, along with social impacts such as increased respiratory ailments and mine safety issues.

[4]Primary energy comprises commercially-traded fuels, including modern renewables used to generate electricity.

[5]Total proved reserves of coal—Generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions.

Table 1 Top 10 coal producers globally 2016*

Country	Coal produced (Mtoe)	Share in global coal production (%)
China	1,685.7	46.1
United States	364.80	10
Australia	299.3	8.2
India	288.5	7.9
Indonesia	255.7	7
Russian Federation	192.8	5.3
South Africa	142.4	3.9
Poland	52.3	1.4
Kazakhstan	44.1	1.2
Germany	39.9	1.1

Source BP (2017)
*estimated

Oil

Oil accounted for 33.9% of the region's primary energy consumption in 1994 (ADB 2013), but this share fell to 27.91% in 2016 (BP 2017). Lacking significant oil resources of its own, Asia depends on imports from other regions, particularly the Middle East. The Asia Pacific share in total global oil production was only 8.7% at the end of 2016, or about 8010 thousand barrels daily. Similar to coal, oil is a finite resource. At the end of 2016 proven world oil reserves totalled 1,706.7 billion barrels, and share of Asia Pacific is only 2.8% (BP 2017).

Nuclear energy

In 2016, about 1.9% of the Asia Pacific's primary energy consumption came from nuclear energy, although the number of new nuclear power plants in The Asia pacific has slowly increased over the years but the total nuclear power generation in the region during 2005–2015 decreased by 2.7% per annum. A major reason for this reduction is coming from the nuclear power plant shutdown in Japan, due to great earthquake and tsunami that hit eastern Japan in March 2011, and damaged the nuclear power plant at Fukushima. This disaster led to the shutdown of all nuclear power plants due to the lack of government safety approvals. In 2016, Global nuclear power generation increased by 1.3%, or 9.3 Mtoe. China accounted for all of the net growth, expanding by 24.5%. China's increment (9.6 Mtoe) was the largest of any country since 2004 (BP 2017). In October 2013, East and South Asia had 119 operable nuclear power reactors, 49 under construction, 100 firmly planned, and many more proposed. The greatest growth in nuclear power is expected in China, Republic of Korea, and India (ADB 2015).

Natural gas

In 2016, natural gas supplied about 11.7% of the total Asia Pacific's energy needs. During 2005–2015 natural gas consumption in the region increased by 5.6% per annum. In 2016, 20.4% of the global natural consumption was in Asia Pacific. Projections suggest that the region's demand for natural gas will increase at an average 3.9% per year, reaching 1,463.2 Mtoe in 2035, 2.25 times the 2016 level of 650.3 Mtoe. An estimated 51.7% of the entire growth in natural gas demand till 2035 in Asia Pacific will be from China, followed by India (13.0%), Indonesia (6.0%), and Japan (4.8%). Natural gas forms when layers of buried plants and animals are exposed to intense heat and pressure over thousands of years. It is non-RE because it cannot be replenished at a rate that matches current and projected consumption levels. In late 2016, proven global reserves totalled 186.6 trillion cubic meters, sufficient to meet 52.5 years of production needs. In Asia and the Pacific, proven natural gas reserves can meet 30.2 years of production needs (ADB 2015; BP 2017).

2.2 Renewable Energy Resources

In recent years, international attention has shifted to RE as a result of increased awareness of the effects of climate change and concerns about energy supply and energy security. RE (e.g., solar, wind, hydropower, geothermal, and bioenergy) is harnessed from natural resources that are virtually inexhaustible or are replenished.

Hydropower

Hydropower is the world's largest clean energy source, in 2016 providing 6.85% of the global primary energy consumption. In same year, in Asia and Pacific share of Hydropower in the total primary consumption was 6.6% (BP 2017). In 2016, Asia and the Pacific consumed 368.1 Mtoe of hydroelectricity or 40.4% of the global consumption of hydroelectricity, compared with 201.8 Mtoe (22.2% share in global) in Europe and Eurasia. Large hydropower plants can have negative environmental and social impacts (e.g., changes in river ecosystems, disruptions to wildlife, and social displacement). In recent years, small-scale hydro installations have been expanding and contributing to increased energy access. Small hydropower plants with a capacity of 10 megawatts (MW) now exist in 148 countries, which could potentially grow to about 173 GW by 2035 (UNIDO and ICSHP 2013).

Geothermal energy

The Asia and the Pacific region is home to some of the world's top producers of geothermal energy. Drawing on the heat of the earth's crust, geothermal energy is used to generate electricity and supply direct thermal energy requirements. Six of the 24 countries producing electricity from geothermal energy are in Asia—China, Indonesia, Japan, Papua New Guinea, Philippines, and Thailand (IEA 2011).

Solar energy

Solar thermal and photovoltaic technologies can convert sunlight into usable heat and electricity. RE globally led by wind and solar power grew strongly, helped by continuing technological advances. Although the share of RE (non-hydropower) within total primary energy consumption remains small, at around 3.1% (in 2016), it accounted for almost a third of the increase in primary energy last year. Although solar energy provides a small contribution to the energy supply in Asia and the Pacific, it is now the region's fastest-growing energy source, albeit from a low base. In 2016 solar energy contributed almost a third of renewable growth, despite accounting for only 18% of the total (BP 2017). Solar energy is enjoying rapid uptake worldwide, and by 2050 it is projected to account for as much as a quarter of all electricity generation (ADB 2015).

Wind energy

Wind turbines harness energy from the wind and convert kinetic energy into electricity. Wind resources are widely available worldwide and its deployment for power has more than doubled since 2008 until 2014, approaching 300 GW of cumulative installed capacities, accounting for about 2.5% of global electricity demand. In 2016 Wind provided more than half of renewables growth. Although wind continued to provide the lion's share of the increase in renewable power, solar is catching up fast. Projections suggest that wind energy could provide up to 10% of all electricity by 2020. In Asia, the estimated potential of wind energy could generate millions of megawatts of electricity. However, the wind energy subsector in Asia generally produces very little electricity, except in the China and India (ADB 2017).

Bioenergy

Biological sources or biomass, such as wood and animal dung, are sources of fuel (through burning or other chemical reactions) and electricity, as well as biofuels (e.g., feedstock). Biofuels are solid (e.g., wood, charcoal, and wood pellets) or liquid (e.g., bioethanol and biodiesel). Biomass is used predominantly in developing countries, mostly in the form of wood and agricultural residues. It is the most common fuel for cooking and heating (Gumartini 2009).

In 2016, globally 82,306 thousand tonnes oil equivalent of biofuels produced. During 2005–2015 global production of biofuels had 14.1% growth rate per annum. In 2016, 45.0% of the global biofuel production was from North America and share of Asia Pacific in global production was 11.1% or 9110 thousand tonnes oil equivalent. Asia Pacific during 2005–2015 in production of biofuel had rapid growth and experienced 25.0% growth per annum.

Figure 1 shows the regional consumption of energy by type of fuel. It also illustrates the dependency of each region on each energy source and provides insights into the energy challenges.

Asia is the leading consumer of oil, coal, hydroelectricity and for the first time in 2016, the leading consumer of renewables in power generation, overtaking Europe and Eurasia. Europe and Eurasia remains the leading consumer of natural gas and nuclear power. Asia dominates global coal consumption, accounting for almost three quarters of global consumption (73.8%).

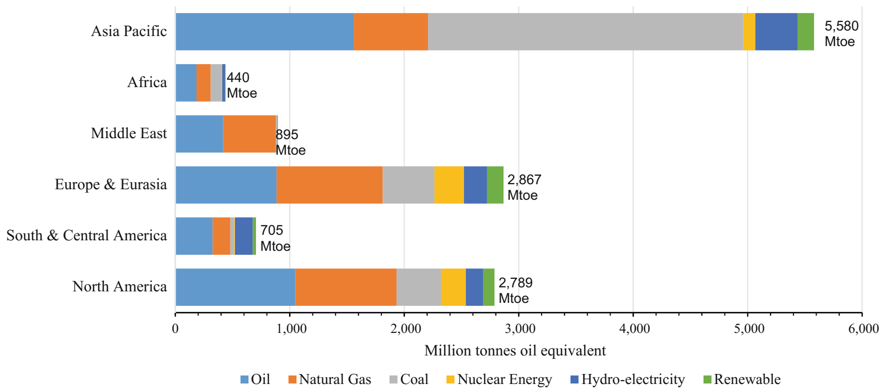


Fig. 1 Regional consumption by fuel 2016. *Source* BP 2017

3 Using Spill Over Effects of Low-Carbon Projects: The Case of Larger Energy Projects

Asian economies are usually characterized as bank-oriented economies. Banks account for the major share of the financial system in almost all Asian countries. Western economies are more capital market-oriented. When looking at the financial assets of households in Asian countries, bank deposits and cash in most of them account for the largest share, with the second largest share accounted for by insurance companies and pension funds. In Japan in 2013, 55% of the total financial assets of households were in the form of cash and deposits at banks, 28% in the form of insurance and pensions, 12% in the form of securities and stock, and 5% in other forms. For American households these ratios were, 15% (cash and deposits), 28% (insurance and pension funds), 53% (securities and stock), and 4% (others), respectively (Yoshino and Taghizadeh-Hesary 2014b). Even in Japan, which has a developed capital market, the share of cash and deposits is much larger than that of securities and stock. In other Asian economies the situation is similar to that in Japan, it means bank dominated financial system, pension funds and insurance companies in second level, and share of capital market is small. This means that banks, insurance companies, and pension funds will be the main source of finance for projects and businesses.

Banks loans are suitable for financing short to medium-term projects because the resources of banks are bank deposits, which typically are short-term or medium-term resources—usually 1 year, 2 years, and at most 5 years (deposits longer than 5 years are very rare). Hence if banks allocate their resources to long-term infrastructural projects (bridges, highways, ports, airports, etc.), mega energy projects (such as large hydropower project) there would be maturity mismatch. Therefore, because banks liabilities (deposits) are short to medium-term, their assets (loans) also need to be allocated to short to medium-term projects rather than to long-term projects.

Insurance and pensions are an alternative for long-term investments (10, 20, 40 years). Large projects, such as big hydropower, gas, or coal-based power plants can be financed by insurance companies or pension funds, as they are long-term (10–20 year) projects. Especially in Asian economies where capital market is not well-developed, pension funds and insurance companies could be a sustainable resource for financing larger RE projects.

Having said that, electricity is a public good so tariffs are often regulated by the government. This makes it difficult for private financial institutions such as pension funds or insurance companies to finance these infrastructural projects. Hence, to increase the investment incentives it is necessary to utilize the spill over effects originally created by energy supplies, and refund the tax revenues to investors in the energy projects (Fig. 2).

Utilizing the increase in tax revenue due to spill over effect of energy supply to private energy projects is fiscal policy reform or a tax innovation. It is possible to measure the spillover effect of an energy project based on economic growth in a specific region. To create an incentive for the private sector to invest in a particular energy project, the government should refund all of or part of the spill over tax to the private sector investor. Yoshino and Abidhadjaev (2017) measured the spill over effects of Uzbekistan's Tashguzar–Baysun–Kumkurgan (TBK) railway connection (infrastructural project). They explained the impact of the project on growth rates of regional gross domestic product (GDP) and sectoral value added using a difference-in-difference methodology; the same method could be used to calculate the spill over effect of energy projects.

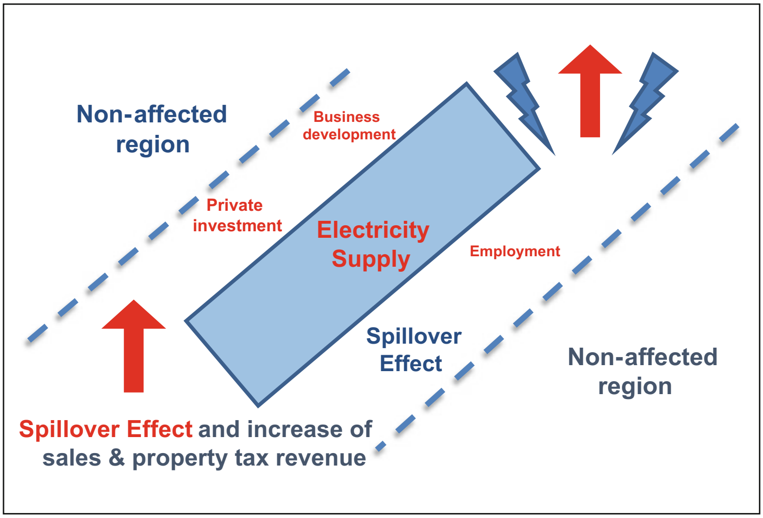


Fig. 2 Spillover effects of electricity supply. *Source* Authors

4 Utilizing Hometown Investment Trust Funds in Development of Smaller-Scale Low-Carbon Projects: Solar and Wind

In Japan, the Hometown Investment Trust (HIT) Funds is a new source of financing created to support solar and wind power. The basic objective of the HIT funds is to connect local investors with projects in their own locality, where they have personal knowledge and interests. Individual investors choose their preferred projects and make investments via the internet (Yoshino and Kaji 2013). One of the major applications of HITs in Japan relates to wind power and solar power projects, which has raised money from individuals (about US$100–US$5,000 per investor) interested in promoting renewable and clean energy. Through these funds, many Japanese people invest small amounts of money in the construction of wind power and solar power. The advertisement of each wind power and solar power project on the internet plays an important role in pushing people to invest in these projects. Internet marketing companies are the companies that provide the platform for investment in these projects and can do marketing of these projects. Local banks have started to make use of the information provided by HIT funds. If these projects are done properly and are received well by individual investors, banks can then start to grant loans for those projects. In this way, RE projects (wind and solar) most of which are considered risky, can be supported by HIT funds until they are able to borrow from banks. The use of alternative financing vehicles, such as HIT funds, has therefore assisted the growth of solar and wind projects in Japan, where the finance sector is still dominated by banks (Yoshino and Kaji 2013; Yoshino and Taghizadeh-Hesary 2014a).

HIT funds have expanded from Japan to Cambodia, Vietnam, Peru, and Mongolia. They are also attracting attention from the Government of Thailand and Malaysia's central bank.

Asia's finance sectors are still dominated by banks and the venture capital market is generally not well developed. However, internet sales are gradually expanding and the use of alternative financing vehicles, such as HIT funds, will help risky sectors in Asia to growth.

The Hokkaido Green Fund, established in 2000 to finance wind power projects in northern Japan, was generated by donations. As it was very difficult to raise money from banks, only 20% of total investment is financed by banks and the other 80% was obtained from individual investors and through donations (Hokkaido Green Fund). The community wind power corporation runs wind power and sells electricity to the power company that supplies power to the region. In many cases, the price of the power produced by wind is 5% higher than that of other forms of electricity, but users are willing to pay 5% extra to save the environment. More than 19 wind power projects were constructed in Northern Japan using a similar method. There is also example of solar power project in Japan, that local government put money (seed money) in the community fund in order to create an incentive for the private investors. There is possibility that these seed moneys be collected in form of carbon tax from polluting industries in order to prevent budget burden for the central government (see Sect. 4.2).

Another example is the revitalization of an old hydropower plant in Nara prefecture in Japan. It was constructed in 1914 but decades later became abandoned and abolished. The local community and individual investors raised money (one unit of investment was US$300) and 274 individuals invested in the revitalization through HIT funds. The total cost amounted to US$500,000 and 184 households received electricity from the revitalized dam and money from the surplus electricity sold to the power supply company in the region.

Although HITs are a form of crowd funding, there are significant differences between HITs and conventional types of crowd funds: (i) there is a "warm feeling" behind the HIT funds, as investors are sympathetic to the company/project owners, who are not solely in it for profit, and their efforts; (ii) investors are ready to receive product or services generated by the project (e.g., the electricity generated by a wind power generator) instead of a share of the profits. This is unlike crowdfunding or venture capital, where profit is the only purpose of investment.

As for the supervision and regulating aspects of HITs, Fig. 3 shows that in Japan, only the intermediate companies (internet companies) that introduce HITs are regulated and monitored by the Financial Services Agency (FSA). FSA does not have any supervision on HITs directly and HITs are not guaranteed by government and the deposit insurance corporation. The intermediate companies are not asset management company; they are only introducing HIT projects for development of various products including innovative goods such as RE projects. They are just acting as an intermediate and therefore does not provide any guarantee. According to Financial Instruments and Exchange Act (FIEA) these companies are categorizing as Type II Financial Instruments Business. With regard to registration as a Financial Instruments Business Operator that only conducts Type II Financial

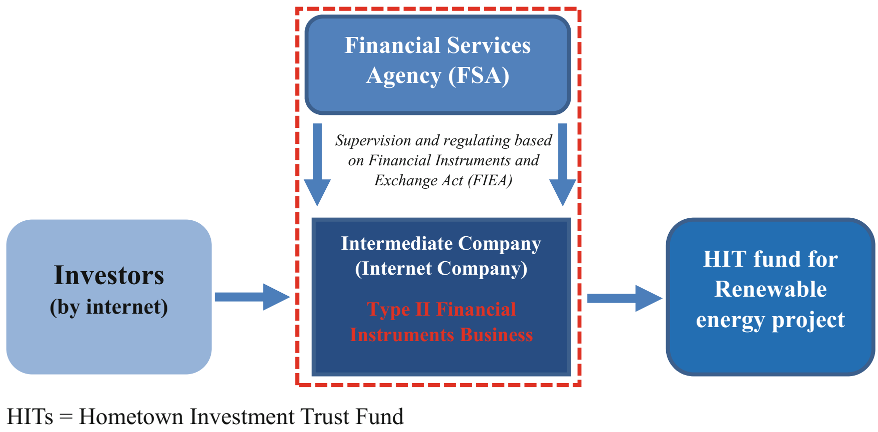


Fig. 3 Supervision of HITs' intermediate companies: case of Japan. HITs = Hometown Investment Trust Fund. *Source* Authors

Instruments Business, the requirements are more relaxed compared to those for the registration to conduct Type I Financial Instruments Business (securities companies, trust companies, etc.) or Investment Management Business. For example, individuals are able to be registered as such Financial Instruments Business Operators, and the only property regulation applied is the minimum amount of stated capital regulation (the deposit for operation regulation in the case of individuals) (Article 29-4 (1) (iv) and Article 31-2 of the FIEA) (FSA 2017).

Pros of HITs

HITs have four main advantages. First, it contributes to financial market stability by lowering information asymmetry. Individual households and firms have direct access to information about the borrowing firms, SMEs and RE projects that they lend to. Second, it is a stable source of risk capital. The fund is project driven. Firms and households decide to invest by getting to know the borrowers and their projects. In this way the fund distributes risk but not so that it renders risk intractable, which was the problem with the "originate and distribute" model. Third, HITs are a form of community-based funds, it contributes to economic recovery by connecting firms and households with SMEs and projects that are worthy of their support and it can promote social and community-based economy. It also creates employment opportunities, as well as for the pool of retirees from financial institutions who can help assess the projects.

Introduction of the hometown investment fund has huge implications in Asia. Asia is seeking a method of financial intermediation that minimizes information asymmetry, distributes risk without making it opaque, and contributes to economic recovery. Funds similar to Japan's hometown investment fund can succeed in all these ways.

Aforementioned pros show that comparing to other relevant schemes in Asia (e.g. Green Technology Financing Scheme (GTFS) of Malaysia that rely on government guarantee and on private bank loans), HITs are a sustainable solution. For instance, GTFS which began on 1 January 2010, provides financial benefits to companies that supply and use green technology, with limits of RM 50 million and RM 10 million respectively (approximately US$15 million and US$3 million). Malaysia Green Technology Corporation (GreenTech Malaysia) administers the GTFS and evaluates projects for certification, entitling applicants to financing incentives. For applications prior to 11 October 2013 the government bears 2% of the total interest/profit rate charged by financial institutions and guarantees 60% of the green loan via Credit Guarantee Corporation Malaysia. The remaining 40% financing risk is borne by the financial institution. From 11 October 2013, the Ministry of Finance announced that GTFS applicants can receive either a 30% green loan guarantee or 2% off the total interest/profit rate (APEC 2014).

A number of GTFS applications have been rejected by financial institutions due to loans being perceived as high risk, suggesting that the Malaysian financial institutions may be unfamiliar with financing low-carbon technology projects, while the applicants may be new businesses and do not meet the credit requirements. Generally speaking, banks are not a suitable source for financing RE projects.

To improve financing environment, GreenTech Malaysia and Sustainable Energy Development Authority (SEDA) Malaysia have been engaging with Malaysian financial institutions so that they become more familiar and comfortable about funding green and low-carbon businesses.

Decoupling the 30% loan guarantee from the 2% discount on interest/profit rate is likely to decrease the attractiveness of the scheme to companies, evidenced by the decline in applications since the changes were announced. It is also likely that financial institutions will now perceive GTFS projects as having an increased risk, especially where loans are not guaranteed by the Credit Guarantee Corporation Malaysia. This may result in a higher number of applications being rejected by financial institutions.

There are several constrains for GTFS in Malaysia:

(1) Economic, financial and technical constraints that impede market performance;
(2) Arbitrary price setting and RE cost-burden on the utility;
(3) Absence of proper RE regulatory framework that provides clear and standardised procedures;
(4) Poor governance detrimentally affecting stakeholders' participation and legitimacy of actions by implementing agencies;
(5) Insufficient institutional measures to meet informational and technological needs; and
(6) High budget burden for the central government because of mandatory credit guarantee (APEC 2014).

Or, HIT scheme are completely different from the financing scheme of solar roof system of China where government financing has significant role. China's solar market at 83 GW in 2016 was the biggest in the world, supporting an industry of panel-manufacturers built up in the nation by government-subsidized lending from institutions led by China Development Bank Corp. Most panels sold into the domestic market have gone to build up massive farms in remote regions, which is a problem because the grid is struggling to build capacity to transmit the electricity to regions where it's consumed. Regulators have tried to remedy the situation by discouraging construction in far-off regions, pushing developers to central and coastal areas where land is scarcer. They also cut tariffs in 2017 for large solar plants in remote areas while incentives for rooftop installations were maintained. As a result, many utility-scale projects have had to curtail power production. The world's biggest solar market idled about 2.3 billion kilowatt-hours of photovoltaic power in the first quarter, up from 1.9 billion kilowatt-hours a year earlier. That has shifted the industry's attention toward installing panels on roofs. Most of China's rooftop solar projects are mainly in the eastern provinces of Zhejiang, Jiangsu, Anhui and Shandong where power demand is greater than in the west. To ease financing concerns, State Grid in April 2017, announced it would roll out financing and other services to China's rooftop market, including providing subsidy-backed loans and collecting end-user payments on the project-owner's behalf (Bloomberg 2017). This means that China's solar roof system is supporting by government subsidized loans, which is different from HITs scheme that grow by communities money. We believe in china also HITs could be a sustainable financing solution for financing and development rooftops without any cost and budget burden for the central government.

Cons of HITs
Such trust funds would not be guaranteed by a deposit insurance corporation and the associated risks would be borne by investors. The terms of a trust fund would have to be fully explained to investors, such as where their funds would be invested and what the risks associated with the investment would be, in order to strengthen potential investors' confidence and help expand the trust fund market (Yoshino and Taghizadeh-Hesary 2014c).

4.1 Theoretical Model for Implementation of HITs

In this sub-section we will explain theoretically why banks are not able to lend to smaller-scale risky sectors such as low-carbon projects (e.g., solar and wind). Equations 1 and 2 present the profit maximization behaviour of banks:

$$\text{Max}\,\pi = r_L L_1 + r_H L_H - \rho_H L_H - r_D D - C(L_1, L_H) \tag{1}$$

Subject to:

$$\text{Bank's balance sheet}\, L_1 + L_H = D + A \tag{2}$$

Equation 1 shows the profit equation of bank (π). We are assuming there are two kinds of loans banks are providing—the first kind are zero default risk loans (L_1) which are ordinary loans provided at a lower interest rate (r_L); the second kind are loans to risky sectors (L_H) at a higher interest rate (r_H). We are assuming that the first group of loans are zero risk and the second group has risk of default (ρ_H). In this equation D denotes total deposits and r_D is the interest rate on deposits. In addition, banks profit is also a function of bank's operational costs (C) such as employee wages and computer and equipment costs, which is a function of both group of loans. The profit maximization of bank is subject to banks' balance sheets (Eq. 2) where A is banks' capital.

$$\rho_H.L_H \leq \theta.L = A \tag{3}$$

$$(\text{Total lending to both groups is denoted by}: L = L_1 + L_H)$$

Each bank has to have enough capital (A) to be able to cover its possible default loan losses ($\rho_H.L_H$). As the risk of default exists only for the second group of loans (high risk loans), the total amount of default loan losses are $\rho_H.L_H$.

We assume that banks are subject to capital requirement rules (Eq. 3), i.e., according to the Basel capital requirement there is 8% capital requirement ratio, ($\theta = 0.08$). Equation 3 means that the default amount needs to be less than 8% of the total loans (total assets) and banks need to reserve at least an equal amount of capital. This means that based on the given amount of capital, if ρ_H goes up, lending to risky sectors (L_H) should go down.

$$C(L_1, L_H) = aL_1^2 + bL_H^2 \tag{4}$$

Equation 4 shows the cost function, which we assume to be a simple quadratic type; it is a function of both groups of lending (L_1, L_H) and applying first order conditions give us two loan supply equations:

$$\frac{\partial \pi}{\partial L_1} = r_L - r_D - 2aL_1 = 0 \tag{5}$$

$$L_1 = \frac{1}{2a}(r_L - r_D) \tag{6}$$

Equation 6 shows the loan supply equation for the first group of loans which are risk- free loans.

$$\frac{\partial \pi}{\partial L_H} = r_H - \rho_H - r_D - 2bL_H = 0 \tag{7}$$

$$L_H = \frac{1}{2b}(r_H - \rho_H - r_D) \tag{8}$$

Equation 8 shows the loan supply equation for the second group of loans, i.e. the risky loans. For this group, as the default risk is high, if ρ_H increases the loan supply falls.

$$L_H \leq \frac{\theta}{\rho_H} L = \frac{A}{\rho_H} \tag{9}$$

Equation 9 shows the upper limit of loan supply to risky sectors due to Basel capital requirements.

Figure 4a shows the case of no capital requirements where the loan supply amount (lending amount) and the equilibrium lending interest rate are derived from the interaction of loan supply and loan demand. Figure 4b shows the loan supply to risky sectors and the demand for it, assuming that banks are subject to the Basel capital requirement. Due to the Basel capital requirements, banks are not able to lend to risky sectors more than $\frac{\theta_0}{\rho_0}L$; if the loan default risk ratio increases the loan supply function shifts to left, in which case the ceiling of lending to risky sectors will lower to $\frac{\theta_0}{\rho_1}L$ with much higher interest rate $(r_H)_1$, which would endanger the feasibility of projects in this sector. This would be an obstacle to the development of riskier sectors such as start-up businesses, or low-carbon projects that need to borrow from banks at high interest rates due to the limitations that the Basel capital

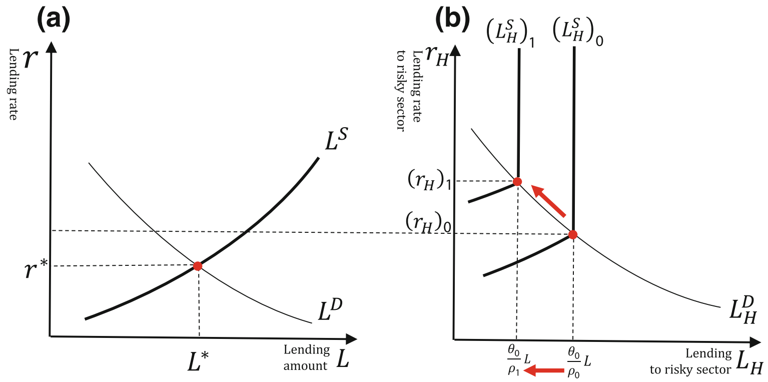


Fig. 4 Lending to riskier sectors and lower upper lending limit for banks. *Source* Authors. Note: L_H^D and L_H^S are risky sector loan demand and supply. ρ_t is risk of default of total loans which is equal to ρ_{Ht} or risk of default of second group of loans (loan to risky sector)

requirement imposes on banks. This means that we need to look for ways to finance riskier sectors such as HITs, while bank lending should be allocated to safer sectors and businesses.

4.2 Utilizing HITs and Carbon Tax in Development of RE Projects

In this section we provide a theoretical model of financing riskier sectors such as low-carbon projects (e.g., wind power generator projects), without relying on bank finance by using other financing channels, here carbon tax and HITs.

Equation 10 shows the profit of a certain HIT (π_h), the resources of which have been allocated to certain risky projects:

$$\pi_h = r_h L_h + t.L_h - \rho_h L_h - r_i L_h - C(L_h) \tag{10}$$

where $r_h L_h$ is the net revenue of the projects HITs resources are allocated to, adding to the tax benefit this HIT receives from the government ($t.L_h$) where t is the tax rate. (e.g., carbon tax the government obtains from the polluting industries and pays to RE projects as a fiscal incentive); there are also risk of default ($\rho_h L_h$) in the projects which need to be subtracted from the profit, $r_i L_h$ is the payment to the investors in the HIT, and C is the construction and operation cost of the projects that needs to be subtracted from the revenue and results in the HITs' net profit.

Assuming $C(L_h) = bL_h^2$, substituting it in Eq. 10 we obtain the first order condition with respect to L_h resulting in Eq. 11:

$$\frac{\partial \pi_h}{\partial L_h} = r_h + t - \rho_h - r_i - 2bL_h = 0 \tag{11}$$

Writing Eq. 11 for L_h results in Eq. 12:

$$L_h = \frac{1}{2b}(r_h + t - \rho_h - r_i) \tag{12}$$

Equation 12 (L_h) presents the supply for HITs, showing that if tax is injected into the HITs, the supply of investment money to these funds will increase and the interest rates trust funds companies have to pay will be lower. So tax injection to encourage investment is very important. In other words, taxing carbon dioxide (CO_2), sulphur dioxide (SO_2), and nitrogen oxides (NO_x) and injecting those taxes to hometown wind power fund or to energy projects directly will increase the supply of money to these projects that banks are reluctant to finance.

Figure 5 shows that if government injects taxes into HITs designed for RE projects, the feasibility of RE projects increases, making these projects more interesting for hometown investors and hence the supply of investment money to these funds will increase (Fig. 6).

On the other hand, if HITs invest in very risky low-carbon projects, this makes hometown investors reluctant to invest their money in these projects, which shrinks the supply of lending/investment to these sectors. Hence, it is crucial for fund managers to check the feasibility and creditworthiness of projects and select only projects with a high probability of success.

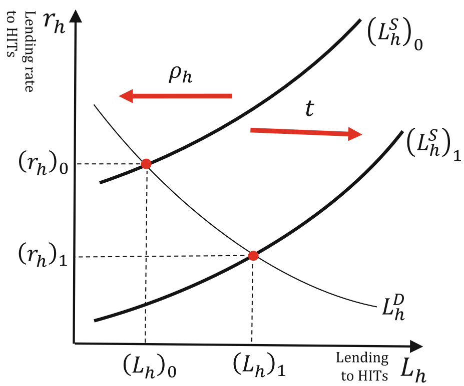
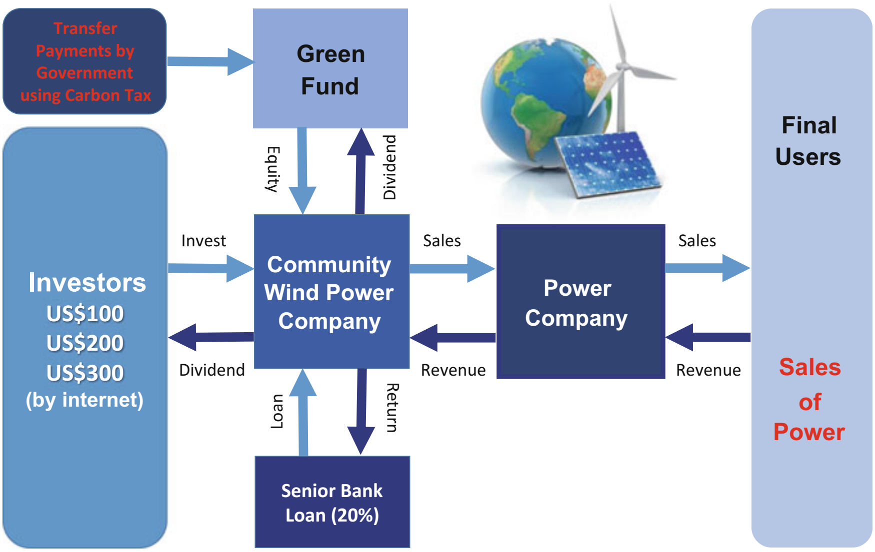


Fig. 5 Injection of carbon tax into RE HITs and higher supply of money to these projects. Note: HITs = Hometown Investment Trust Funds. L_h^D and L_h^S are demand of HITs for money and supply of investment/lending money to HITs, respectively. *Source* Authors



HITs = hometown investment trust funds.

Fig. 6 Financing Scheme for RE projects using HITs and carbon tax. HITs = Hometown Investment Trust Funds. *Source* Authors

4.3 Stable Supply of Risk Capital to Low-Carbon Energy Sector

Due to environmental issues and to increase energy self-sufficiency with a view to improving energy security in Asia, greater reliance on RE resources is crucial. But as mentioned above, lack of access to finance is an obstacle for RE projects development.

Asia has bank-centred financial systems and although they offer micro credit, they loan out money at high interest rates. Thus, risky borrowers such as low-carbon energy projects are struggling. It is essential that the HIT funds discussed here develop in Asia as investment alternatives to micro credit and venture capital.

For infrastructure investment or larger energy projects, it will in future also be possible to put together funds in the form of infra funds (infrastructure investment trusts) and to implement project finance. When considering the establishment of HIT funds for Asia for investment projects (such as energy projects) that demand long-term funding, the question will be whether HIT funds can put together financing that will be stable for 5 years, 10 years, or even longer periods.

In the United States and Europe, venture capital and other funds tend to operate in the short term. Money from life insurance companies and pension funds is best suited for stable long-term funding. If private pension funds also begin to participate, demand will emerge in tandem with long-term HIT funds as places for them to invest. To engage in long-term fund management, it will be necessary for Asia to provide for an increase, on the fund-providing side, in pension funds and life insurance companies that seek long-term investment.

4.4 Fostering Sound Hometown Investment Trust Funds

HIT funds, forest investment funds for environmental protection, infrastructure funds, and other type of such investments are also expected to appear not only in main urban areas. When they do, it will be necessary to prevent the rise of unscrupulous investment fund companies that offer inferior projects for investment and have no commitment to the projects of the companies invested in that will lead investors into loss.

When HIT funds are on a small scale, it is expected that many individual investors will consider the investment as a support for the local region (i.e., solar power or wind power in a village). They are expected to consider the investment trust to operate as a combination of contribution and investment. A variety of different regional assistance funds have come into play, including HIT funds for the purpose of development of solar power and wind power in Japan. After the Great East Japan Earthquake that resulted in a nuclear disaster, people are becoming more interested in non-nuclear clean energy resources (i.e., solar and wind) and starting to develop HITs for development of their projects. HITs are expanding in Thailand, Philippines, Mongolia, and also in many other countries outside Asia, for example in Peru.

The fund operators will have to set up a self-regulating organization that checks the activity of each other's fund and cultivates excellent operators who will maintain the confidence of investors. This is necessary, otherwise the HIT funds that have finally managed to grow will lose credibility, people will discourage to invest in the future and HIT funds will not expand. It will also be desirable to create a system whereby the Financial Services Agency or other government authority monitors the operators as they do in Type II Financial Instruments Business Operators and eliminates unscrupulous operators.

5 Concluding Remarks

Fossil fuels, especially coal, are the main sources of fuel for the emerging Asian economies. Excessive reliance on fossil fuels, especially coal, is a major cause of GHG emissions in this region. Low-carbon energy projects are sustainable solutions for mitigating the climate warming issues from the current critical level. Southeast Asia that host several emerging economies such as Thailand, Vietnam, Indonesia and Myanmar are among the world's highly polluted regions. Carbon or environmental taxation is one of the solutions to protect the environment and forcing polluting industries to shift to clean energy resources (solar, wind, and geothermal).

Taxes can directly address the failure of markets to take environmental impacts into account by incorporating these impacts into prices. Environmental pricing through taxation leaves consumers and businesses the flexibility to determine how best to reduce their environmental footprint. This enables the lowest-cost solutions, provides an incentive for innovation and minimises the attempt for government to pick winners (OECD 2011).

Another necessity for development of low-carbon energy projects is raising energy self-sufficiency and energy security through diversification of energy resources. Too much reliance on limited resources of energy (coal, oil, or gas) will reduce the resiliency of the economy and make it more prone to energy price fluctuations. Hence emerging Asian countries need to diversify their energy basket.

One of the main obstacles to development of low-carbon and RE projects is lack of access to finance. Most Asian economies (China, Thailand, Indonesia, and Malaysia) are bank dominant and the share of the capital market in their financial systems is very small. Hence, banks are the major source of financing projects, but they do not have long-term assets because most of their liabilities are short-term and medium-term (short-term and medium-term deposits of up to 5 years). After banks, in most of Asian economies, insurance companies and pensions have the second largest share of the financial market. Savings at insurance companies are predominantly long-term (10, 20, or 40 years), which means insurance companies and pension funds can allocate their resources to long-term projects such as infrastructural projects or mega energy projects (large hydropower projects, gas-based power generation projects, etc.). On the other hand, electricity tariffs are regulated by the government and kept at low rates. Hence, to increase the investment incentives, the spill over effects originally created by energy supplies need to be utilized and tax revenues refunded to investors in energy projects, this is a form of a fiscal policy reform. This is one of the policy implications of the paper that governments need to consider the spill over effect of supply of energy by private sector especially in non-electrified regions. Then, the entire increase in the tax revenue or a portion of it due to more output in the region because of electrification need to be injected to the private energy projects specially into low-carbon energy projects in order to increase the rate of return of these projects.

For smaller-sized projects, the paper theoretically and empirically introduced a combined model of carbon tax and a new way of financing risky capital, i.e. HITs. HITs are a form of crowd funding, although there are significant differences between HITs and conventional types of crowd funds: (i) a "warm feeling" is behind the HITs, because investors sympathize with the company/project owners and they are not merely seeking to make a profit; and (ii) investors are prepared to accept products or services generated by the project (i.e., the electricity generated from a wind power generator in a small village) rather than insist on a share of the profit. In crowdfunding or venture capital, by contrast, profit is the only purpose of investment. HITs are applicable in different parts of Asia regardless of the development stage. HITs are able to provide a community-based sustainable financial solution for low-carbon energy projects especially for non-electrified regions for bringing sufficient capital for establishment of off-grid or on-grid electrification.

After Fukushima Nuclear disaster in Japan in March 2011, HITs provided the solution for collecting sufficient capital from people whole were living in the disaster area and from all over Japan for establishment of several solar and wind power projects and generating green energy. Governments by taxing carbon dioxide (CO_2), sulphur dioxide (SO_2), and nitrogen oxides (NO_x) and allocating those tax revenues to HITs, will make the RE projects more feasible and more interesting for hometown investors, hence the supply of investment money to these funds will increase. It is important to highlight that if HITs invest in very risky RE projects, hometown investors will be reluctant to invest in such projects, which will reduce the supply of lending/investments to these sectors. It is crucial, therefore, that fund managers carefully assess the feasibility and creditworthiness of projects and only select those with a high probability of success.

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