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RESEARCH ARTICLE

GREEN SUSTAINABLE AIRPORTS: THE DEPLOYMENT OF RENEWABLE ENERGY AT VIETNAM AIRPORTS. IS THAT FEASIBLE?

Vu Hai Nam*

Ho Chi Minh City University of Transportation, No. 02 – Vo Oanh Str., Ward 25, Binh Thanh Dist., Ho Chi Minh City, Vietnam
Corresponding Author E-mail: nam.vu@ut.edu.vn

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ABSTRACT

The aviation industry is responsible for up to 2.5 per cent of global CO2 emissions, according to the UN Intergovernmental Panel on Climate Change. Although the aviation sector will not transform to an environmentally friendly industry overnight, airports have the ability, the means and the opportunities to invest in sustainable development. Particularly, renewable energy could be an alternative scenario to escape the dilemma between the urge of high growth and the concern on environmental damage in air transport. The benefit is that renewable energy increases the options available to airports for their energy needs. There also provides with other advantages, i.e. producing fewer emissions and reducing the environmental footprint. In addition, installing renewable energy generation technologies on site at an airport can lower the carbon footprint with minimal impact to airport operations. The question is whether the deployment of renewable energy in Vietnam airports for becoming more "green (eco-friendly), sustainable" airports could become feasible when taking into account both prospects and challenges in such field. So as to answer, this paper will summarise the deployment of renewable energy in airports worldwide, then critically assess both prospects and constraints of renewable energy projects in Vietnam. Some experiences from the Europe airports, through applying the "Green Sustainable Airports (GSA)" and "Airport Carbon Accreditation" programmes to establish and boost strategies and solutions for more eco-friendly and efficient regional airports should be useful to provide suggestions.

KEYWORDS

Airports, renewable energy, Vietnam, INWASCON.

1. INTRODUCTION

The Paris Agreement, entered into force on 4 November 2016[1], has the central aim to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius [2]. Individual countries or Parties will have to nationally determine their contribution to these targets, and all sectors of society will need to contribute.

The air transport, including the aviation sector (e.g. airports, airlines, general aviation, air navigation services and auxiliary activities directly serving passengers or providing airfreight services) and the civil aerospace sector (manufacture and maintenance of aircraft) [3], is a one of the world's fastest growing industry today [4]. As air traffic grows so then does aviation's overall impact upon the environment. These effects have wide ranging implications at the local, regional and global levels [5]. Controlling emissions caused by the aviation industry is an important task while the aviation sector is a top-ten global emitter and for 4.9% of the warming impact on the Earth.

Particularly, emissions from electricity consumption contribute to more than 98% of total energy- related emissions [6]. Airports are facilities similar to small or medium-sized cities which need a huge source of energy to operate their infrastructure and to provide their services. As a result, the safe, economic and most importantly, reliable provision of electricity at airports is of great importance, on the one hand, while the potential impacts from climate change are taken into account due to most of energy sources are heavily relying on the use of fossil fuels, on the other hand [7].

Against this background, renewable energy could be an alternative scenario to escape the dilemma between the urge of high growth and the concern on environmental damage in air transport. Renewable energy is defined as energy from a source that is not depleted when used that are consisted of common sources such as solar, wind, geothermal, hydro, and some forms of biomass [8]. The benefit of renewable energy that increases the options available to airports for their energy needs. Most airports buy electricity from a power provider, making energy use a major operating cost for the airport; thus, energy efficiency is a basic cost control measure. There also provides with other advantages, i.e. producing fewer emissions and reducing the environmental footprint. In addition, installing renewable energy generation technologies on site at an airport can lower the carbon footprint with minimal impact to airport operations (e.g., solar panels on rooftops) [9][10].

Given the fact that the development of renewable energy in Vietnam is at its infancy, it has a great potential to develop and include different renewable energy sources [11]. The government has laid out a number of policies and strategies for development of energy sector, inter alia, the masterplan for exploitation and production of domestic energy sources [12], and the strategy for increase of generating and use of renewable energy [13], and the national power plan which is under the revision of Ministry of Industry and Trade [14].

Regarding above issues, the question is whether the deployment of renewable energy in Vietnam airports for becoming more "green (eco-friendly), sustainable" airports could become feasible when taking into account both prospects and challenges in such field. So as to answer, section 2 will summarise the deployment of renewable energy at airports worldwide. Section 3 will critically analyse both prospects and constraints of the renewable energy projects in Vietnam. Then section 4 will provide some experiences from the Europe airports, through applying the "Green Sustainable Airports (GSA)" during 2010-13 and "Airport Carbon

Accreditation" programmes to establish and boost strategies and solutions for more eco-friendly and efficient regional airports. Based on this analysis, suggestions are provided.

2. THE DEPLOYMENT OF RENEWABLE ENERGY AT AIRPORTS

Airports are facilities similar to small or medium-sized cities which need a huge source of energy to operate their infrastructure and to provide their services efficiently. Terminal buildings require electricity for lighting, air conditioning and other building systems, and power to serve the needs of airport administration and the airport's tenants to conduct typical business activities. In turn, energy is a significant cost for airports [15]. For example, in the United States, energy makes up about 10 to 15 per cent of operating budgets at airports. With the exception of personnel, it is the single largest airport operating expense. As a result, the airports are the largest consumers of energy, they are also the most efficient users of energy on a per passenger basis[16].

Airports purchase electricity from the national grid, a vast network of electricity transmission lines and power flow control facilities. "The grid" is supplied by a variety of generators, given that the majority of electric grids are powered by fossil fuel fired power stations which use coal, oil, and natural gas produce carbon-intensive electricity while renewable energy plants produce carbon-free electricity, sometimes referred to as "green" power[17].

There are several types of opportunities for converting airport power sources to renewables: on-site electricity, gate electrification, electric GSE, and alternative ground transportation. Firstly, renewable electricity facilities, such as solar PV, have been installed successfully at airports around the world, although physical locating the renewable electricity facility on-site is one challenge, and matching its generation with airports' existing consumption is a further challenge. Because an airport's electricity is typically supplied by the electric grid, the advantage is that the development of on-site electricity fundamentally reduces the demand for off-site power. The on-site generation may exceed on-site use allowing the surplus generation to spill back to the grid. In addition, there may be opportunities to transition an existing fossil fuel combustion energy source currently on-site (small-scale power generators used in isolated areas) to electricity generated with a renewable source, thus reducing carbon emissions from an on-site activity[18].

For example, Cochin International Airport, located in the southwestern coastal state of Kerala, the travel hub is the seventh busiest airport in India became the world's first solar-powered airport in 2015, when it transformed a patch of land previously reserved for cargo handling into a 12-megawatt solar plant. This energy source provides all the power the airport needs, and even generates surplus for the state grid [19].

Another step in eliminating emission sources from aircraft pre-conditioned air (PCA) and mobile diesel-powered ground power units (GPU) powered by fossil fuels is gate electrification to enable to aircraft to obtain power and cooling from the terminal. The PCA and GPU can either be attached to the passenger boarding bridge or installed on the apron as ground-mounted systems [20]. For example, Los Angeles International Airport (LAX), which has converted all of its gates to electricity, gate electrification was estimated to be about 14 per cent of the terminal load. Frequently, the gate units are equipped with electric submeters to track the electricity consumed in order to adequately charge the airline, as well as to measure emission reduction benefits [21].

The energy uses associated with an airport also includes the fuel necessary to power ground support equipment (GSE), which is defined as all off-road equipment used on the aircraft side at an airport. This includes pushback tugs, baggage and cargo tractors, carts, lifts, forklifts, ground power units, air conditioning units, and belt loaders [22]. When GSE is owned by the airport, cooperation is also required with airlines to convert existing fossil fuelled vehicles to electric power. In such cases, the airline would agree to pay for the conversion of the GSE, while the airport would commit to installing electric charging stations on the apron where the GSE could charge. The authorities also offer incentives for firms that want to replace their old propane, gasoline, as diesel GSE with new electric equipment.

In addition to electrifying gates and GSE, there are opportunities to reduce emissions from other ground transportation arriving and departing the airport. Installing electric charging stations is an example of how an airport can support sustainable ground transportation. Airports can also transition their own parking shuttles and service trucks from traditional gasoline and diesel to cleaner burning natural gas and renewable electric vehicles [23]. For instance, Aena, Spain's airport operator which is 51% state owned, plans to install solar panels in 20 out of the 46 airports it has in Spain, focusing on the ones with more available land and sunlight. This will also plans to replace all of its passenger vehicles with non-polluting ones by 2025 and to install 2,300 charging stations for electric vehicles in its airport parking lots [24].

In Vietnam, there have been a number of off-grid projects around Danang, the greenest city in Vietnam, including its airport. The Da nang Energy Conservation and Technology Consultant Centre (DECC), under the city's Department of Science and Technology, will design a pilot basis and build a database of solar power capacity in the city as well as a policy framework for clean energy development. The project, funded by the EU to the tune of US$ 447,000, aims to increase accessibility to clean energy and raise awareness among businesses and households on solar power, energy saving and environmental protection[25].

Pioneering airports across the globe have participated in the deployment of renewable energy at their facilities. As renewable energy systems have become increasingly economical to deploy, and airports and their stakeholders have become more aware of the economic, environmental and social benefits that renewable energy provides, this growth in the deployment renewable energy has continued. Among others, two main driving factors are comprised of sharp cost reduction for solar photovoltaics and wind power, and supportive government policies [26]. As a result, it is advisable for the Vietnam governments to continue the momentum of legal reforms and financial incentives for encouraging the application of advanced technologies to meet high standards on environmental protection and energy security[27].

3. RENEWABLE ENERGY PROJECTS IN VIETNAM: PROSPECTS AND CONSTRAINTS

Vietnam has experienced the rapid economic growth, the industrialisation and modernisation of country which are fuelled by the consecutive increase of energy production and consumption. The rate of annual energy demand has risen by 4.1 percent on average, from 273.3 to 454.8 kgOE per person during a decade (2006 – 2015) [28]. Moreover, the primary energy sources have significantly changed with the transformation of an agriculture-based biomass to a modern mixed source, including crude oil, natural gas, coal and hydropower. Among others, natural gas had the highest growth rate with 13.4 percent yearly, while the rate of coal, oil and hydropower were of 12.2 percent, 6.2 percent and 27.6 percent respectively [29].

However, this sector is facing tough challenges: first, the growth in energy demand, particularly the rapid growth of electricity demand, has resulted in the great pressure on production side whereas neither change in the total output of main domestic energy sources [30]. Vietnam therefore has become a net energy importer, with the outstanding rate of about 5 percent of total supply since 2015, which is forecasted to consistently rise, accounting for 37.5 percent in 2025 and 58.5 percent in 2035 [31].

Second, with the speed of energy consumption, energy resources are being depleted. Most of the potential for large and medium hydropower plants will be fully exploited where the capacity will slightly increase from18 GW to 21.6 GW in 2020. Meanwhile, the domestic coal is currently insufficient to supply for coal-fired power plants, and petroleum resources will be reduced and depleted around next 60 years. There would be no exception for Vietnam in the trend that all of countries endeavour to find alternative energy sources [32].

Third, the shift to fossil energy has raised concerns about the environment damage. Over decades Vietnam had the highest greenhouse gas (GHG) emissions in the ASEAN, with the GHG emissions (metric tons per capita) had roughly five times between 1986 and 2014 [33]. In compliance with international commitments, such as the Paris Agreement recently, Vietnam is urged for minimizing environmental pollution by the stricter regulations and enforcement. There are three core elements of reform agenda to sustain the environment: protecting the quality of natural resources; building climate resilience in economic planning, sectoral policies, infrastructure investment; and finding solutions to tap more clean energy sources that call for strong policies and institutions to

coordinate actions, with private participation[34].

Being aware of the dependence on imported energy sources, environmental concerns of large hydropower plant projects, the relatively slow development of the natural gas industry, as well as the government's decision to suspend nuclear power development, the renewable energy is generally viewed as a viable alternative to meet Vietnam's future power needs, evenly the current ratio is very limited to below 1 percent of total capacity [35].

Overall the development of renewable energy is at a very early stage, yet Vietnam has a high potential for different renewable sources, including wind, solar, biomass and geothermal energy [36]. Vietnam has witnessed a boom in renewable energy projects which is expected to grow at 23.2 percent annually during 2020-30, indeed. At the moment, over 200 renewable energy projects have been identified, are being deployed at different stages. If all of these projects begin operation, the total capacity of renewable energy should reach 23.2 GW, which is nearly 10 times rather than the target of 2.65 GW by 2020 in the Revised National Master Power Plan VII. Yet the development progress is very low as only 8 percent of such projects are ready for operation, other 19 percent reached the construction stage while the remaining are stuck in preparation phase [37].

Given that Vietnam government has laid out a number of policies and strategies for development of energy sector, inter alia, the masterplan for exploitation and production of domestic energy sources [38], and the strategy for increase of generating and use of renewable energy [39], and the national power plan which is under the revision of Ministry of Industry and Trade (the Prime Minister, 2016). Besides the regulatory framework, there are researches to provide the status of affairs in domestic energy market, development trend in the perspective of global and regional movement, opportunities and constraints which business players are facing, and recommendations to build a more liberalised, fairly competitive and efficient energy market in Vietnam.

One of key studies is the ***Vietnam Energy Outlook Report 2017*** which was aimed to provide an analysis of available data for formulating the energy sector planning, and overall development directions for energy sector[40]. More importantly, the report highlighted both opportunities and challenges of the integration of renewable energy into the national power grid. In the past, the government has played a vital role of securing investment in the energy sector, through mobilization of state finance from state-owned enterprises (SOEs) and introduced development policies which partly incentivized investment capital from non-State sectors. At present, Vietnam however needs to build an appropriate policies and legal framework to secure a competitive and attractive investment environment, favouring new and advanced technologies complying with the national policies of environmental protection and energy security[41].

Other paper namely ***Vietnam: Maximizing Finance for Development in the energy sector*** published by the World Bank Group [42] has shown that Vietnam has experienced double digit growth in energy demand, calling for continued high levels of investment in the energy sector. Nonetheless, as similar to the aforementioned report, the traditional financing model for energy infrastructure which mostly relied on public investment, backed by government guarantees is no longer sustainable. Meanwhile, foreign and domestic private sectors are facing significant constraints, including the inappropriate public-private partnership structures, the limitation of state-owned enterprises to approach the international financial market, and the undeveloped local capital market [42].

In order to pave the new wave of larger financial sources in energy infrastructure investment, it thus requires the major coordinated policy with three main pillars: first, the State is responsible for harmonising and integrating legal framework for investment under the form of public-private partnerships (PPPs). In addition, the government should consider running a substantial project pipeline through competitive bid to establishing a strong track record of speedily and competitively implement PPP and increase the investor confidence over time. Second, while the central role of SOEs has still been insisted, there increasingly stresses the improvement of financial performance in corporate balance sheets, and subsequent obtaining credit ratings for approaching international financial market, without recourse to the State. Third, it calls for a concerted effort to facilitate the domestic capital market, including the commercial loans, and corporate bond market.

4. EXPERIENCES FROM THE EUROPEAN UNION

Production of primary energy in the EU totalled 755 million tonnes of oil equivalent in 2016 which was lower than those in previous years and continued a generally downward trend [40]. The reduction in the EU's primary energy production may partly be attributed to supplies of raw materials becoming exhausted and the exploitation of energy sources uneconomical and/or dominance from external energy suppliers (e.g. the Russian Federation). As a result, the downturn in primary production of energy sources, such as coal, petroleum resources and more recently nuclear power, has resulted in a situation whereby the EU has become increasingly reliant on primary energy imports to satisfy the demands [43].

The EU's dependence on energy imports thus forms the backdrop for policies regarding energy security. In November 2010, an initiative called 'the Energy 2020: a strategy for competitive, sustainable and secure energy' was adopted by the EU Commission, which defined particular priorities for a period of ten years to tackle a variety of challenges including advancement of energy efficiency, building an integrated energy market with competitive prices and secure supplies, boosting technological leadership, and strengthening the external dimension of the EU energy market through cooperation with international partners (European Commission, 2010). In line with its priorities, the EU has been major driving force behind global efforts in this area. For example, the sectors focusing on enhancing energy efficiency have seen a steady increase in investment globally: in 2016, global investment in energy efficiency increased by 9 percent to $231 billion, 30 percent of which (the largest share) came from the EU [44].

This vision and targets have been further developed in the 2030 strategy agreed by the European Council in October 2014 [45]. The targets therein aim to help the EU in obtaining a more competitive, secure and sustainable energy system and meeting the targets of 2050 greenhouse gas reduction. To achieve the ambitious goals of reducing the EU's greenhouse gas emissions by 80 – 95 percent by 2050[46], the 2050 Energy Roadmap set out four main routes: energy efficiency, renewable energy, nuclear energy, and carbon capture and storage. Therefore, the significant investment in new low-carbon technologies, renewable energy, energy efficiency and grid connection infrastructure needs to be implemented as soon as possible[47].

Particularly, given that small and medium sized airports are crucial for regional accessibility and competitiveness, the "*Green Sustainable Airports*" project had been launched between July 2010 and September 2013, funded nearly €3.8 million to tackle the challenges of regional accessibility, sustainability and regulation. "*Green Airports*" was modelled to decrease green-house gas and noise emissions as well as operation specific waste volumes, to increase energy efficiency and surface accessibility of airports by innovative concepts on public transportation. As cross sectional objective the project comprehensively focuses on regional airport communication, regional cooperation and policy resolutions to safeguard the role of regional airports as accessibility gateways by improving public perception and acceptance.

Besides, Airport Carbon Accreditation (ACA) is a voluntary emission reduction scheme launched in 2009 by Airports Council International Europe (ACI Europe), aimed to reduce airports' climate impact by assessing and recognizing their efforts to reduce green-house gas emissions, independently administered, institutionally-endorsed and has the support of the international organisations (such as United Nations Framework Convention on Climate Change (UNFCCC), United Nations Environment Programme (UNEP), the International Civil Aviation Organisation (ICAO), US Federal Aviation Administration and the European Commission (EC)[24]. Airports can become accredited at four progressively ambitious levels of accreditation. Level 1 Mapping mentions to a policy commitment to emissions reduction endorsed by top management and the development of a carbon footprint for emissions. Then level 2 Reduction targets to the formulation of a carbon emissions reduction target, development of a Carbon Management Plan to achieve the target and annual reduction of emissions. Level 3 Optimization further requires the development of a more extensive carbon footprint and the formulation of a Stakeholder Engagement Plan to promote wider airport-based emissions' reductions. Lastly, level 3+ Neutrality proposes offsetting

credits to compensate for the remainder of emissions, so-called residual emissions [48].

Following COP24 UNFCCC Climate Change Conference in Poland by December 2018, Airports Council International provided an update on the latest developments of 259 airports currently in the global carbon management standard, whereby the total number of accredited airports in Europe to 133, accounting for 65 per cent of European passenger traffic and 56 per cent of all accredited airports in the programme. By the end of 2018, 35 out of 133 airports are carbon neutral, which means 35% progress towards the ACI EUROPE target of 100 carbon neutral airports by 2030.

It is also noteworthy that there is no record of Vietnam airport under ACA programme while other ASEAN Member States, such as Cambodia (3 mapped airports), Malaysia (1 optimised airport), Singapore (1 optimised airport) and Thailand (5 optimised airports), are endeavoring to fulfill the requirements to achieve higher level of carbon accreditation (ACA, n.d). It urges the attention of authorities, airport companies and other stakeholders on the common efforts to reduce damage of climate change and fulfillment of Paris Agreement's commitment where Vietnam is one of Members [25].

5. RECOMMENDATIONS AND CONCLUSION

The strategic measures are required which can be broadly categorized in the areas of commitment, coordination, capacity building, measurement and reporting, market measures and adaption.

The Vietnamese government has actively supported decisive action on climate change in the international and domestic arenas. Most recently it has reinforced its commitment to addressing aviation emissions in it recently released the "*Action Plan on Climate Change Adaptation and Green Growth of the Ministry of Transport for the Period 2017 – 2020*" (Decision 4206/QD-BGTVT dated 28 December 2016), based on the Decision 1277/QD-TTg dated 31 July, 2014 by the Prime Minister providing approval of the Policy Framework for the Support Program to Respond to Climate Change (SP-RCC).

This Action Plan has identified six groups of measures to reduce CO2 emissions in the civil aviation of Viet Nam, including:

- Tasks and technical solutions for aircraft;
- Flight management measures;
- Improvement of operations at airports;
- Gradual shift to alternative fuels and energy efficiency application of vehicles and equipment;
- Market-based solutions for emissions management;
- Management solutions, international cooperation.

Among others, deployment of renewable energy is a mean to improve the efficiency and address carbon emissions reductions from the airports' operation.

Given that there are a number of avenues for expanding and diversifying sources of investment finance, each one of them faces significant challenges for implementation. There is consequently a need to make a paradigm shift that will substantially expand the availability of capital to the energy sector, while reducing the burden on the state. Two groups of recommendations are comprised of developing clear and transparent PPP policy framework and building institutional capacity and improving the availability of local currency facility that could benefit renewable energy projects.

First, the government needs to recognize that the efficiency and improved infrastructure services gains that can be accrued through successful PPPs are, over the long term, more important than the simple objective to mobilize private investment and to help fill a public sector budget gap. In this context, government needs to ensure greater policy clarity and consistency with respect to opening up more private sector participation opportunities. Given a conducive, clear, and consistent PPP-enabling framework, followed through by predictable and transparent execution of PPP-related processes, the private sector will certainly respond if they see reasonable PPP opportunities to make a fair return on their investment capital.

Vietnam has recently made progress in harmonizing and integrating the legal framework for PPPs, including the planned separate legislation governing PPPs (The National Assembly's Resolution No. 437/NQ-UBTVQH14), this still falls short of what is needed to start a major new program PPPs on the large scale of to address the energy sector investment. The standard risk allocation currently being proposed in the wind, solar and hydro PPAs appears to be generally not acceptable to international investors. To attract private sector investors and operators, a transparent policy framework and fair allocation of risk are crucial. Particularly, authorities are needed to clearly define project scope and clarify a risk-sharing mechanism in the PPA, acceptable credit support agreement and related documentation which will help to encourage participation in PPP deals.

Secondly, despite the central role of commercial loans, the OECD has witnessed an increasing trend of using bonds to finance large scale energy infrastructure projects directly or to fund lending. Some characteristics of bonds make them more attractive to investors: firstly, bonds are more standardized capital market instruments which enhances the liquidity of the instrument, provided that the size of bonds market. Second, bonds can be issued with maturities longer than the tenors of loans that banks normally accept. Third, if well structured (e.g. convertible bonds), a bond issuance can benefit from a comparatively lower cost of funding and from less stringent covenants than a traditional loan.

Against this background, the Prime Minister has approved a strategy for the development of Vietnam bond market for the 2017-2020 period with a vision to 2030, which is aimed to develop a stable, complete and synchronous bond market, increase the scale and quality of products, and integrate into the international market, with a step-by-step approach to good practices (the Prime Minister's Decision No. 1191/QD-TTg dated 14 August 2017). The remarkable milestone is the new Decree No. 163/2018/ND-CP on issuing corporate bonds, in order to overcome the limitations during the implementation of the former Decree No. 90/2011/ND-CP. One of significances of Decree 163 is to explicitly provide the concept of "green" corporate bonds as the corporate bonds to exclusively use the funds raised to finance "green" projects, assets or business activities under the Environment Protection Law (Decree No. 163/2018/ND-CP, s.4.3).

In a global perspective, the momentum of market demand and government-led efforts at standardization and definition in green bond market have been fruitful, with the emergence of principles and guidelines recognized and backed by the public financial institutions and development banks, for example, the Green Bond Principles – a self-regulatory initiative to designed to promote transparency and disclosure in the market, the Climate Bond Standards (OECD & Bloomberg Philanthropies, 2016). A market for bonds specifically self-labelled or designated as "green" has emerged since 2007, and quickly increased to value of USD 1.8 billion in 2018.

For example, Amsterdam's Schiphol Airport has become the first in Europe to sell green-labelled debt, in a deal that underlines the tensions in the rapidly expanding environmental finance market. It plans to use the money from the sale to finance energy-efficient buildings, electric vehicles for passenger transportation and other clean transport.

To sum up, this paper includes two groups of recommendations: developing PPP policy framework and building institutional capacity and enhancing the facilities for domestic capital market. However, these recommendations still require additional consultations: first, discussion and consultation among government state agencies is important to build broader consensus. Second, further technical assistance is required to develop these concepts into practical policies, institutional mechanisms and action plans for the government consideration. Third, more researches to relevant countries can help to build more understanding and to identify the best path forward to develop. Finally, a pilot project to demonstrate the benefits of each approach will help to develop the institutional capabilities of state agencies.

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