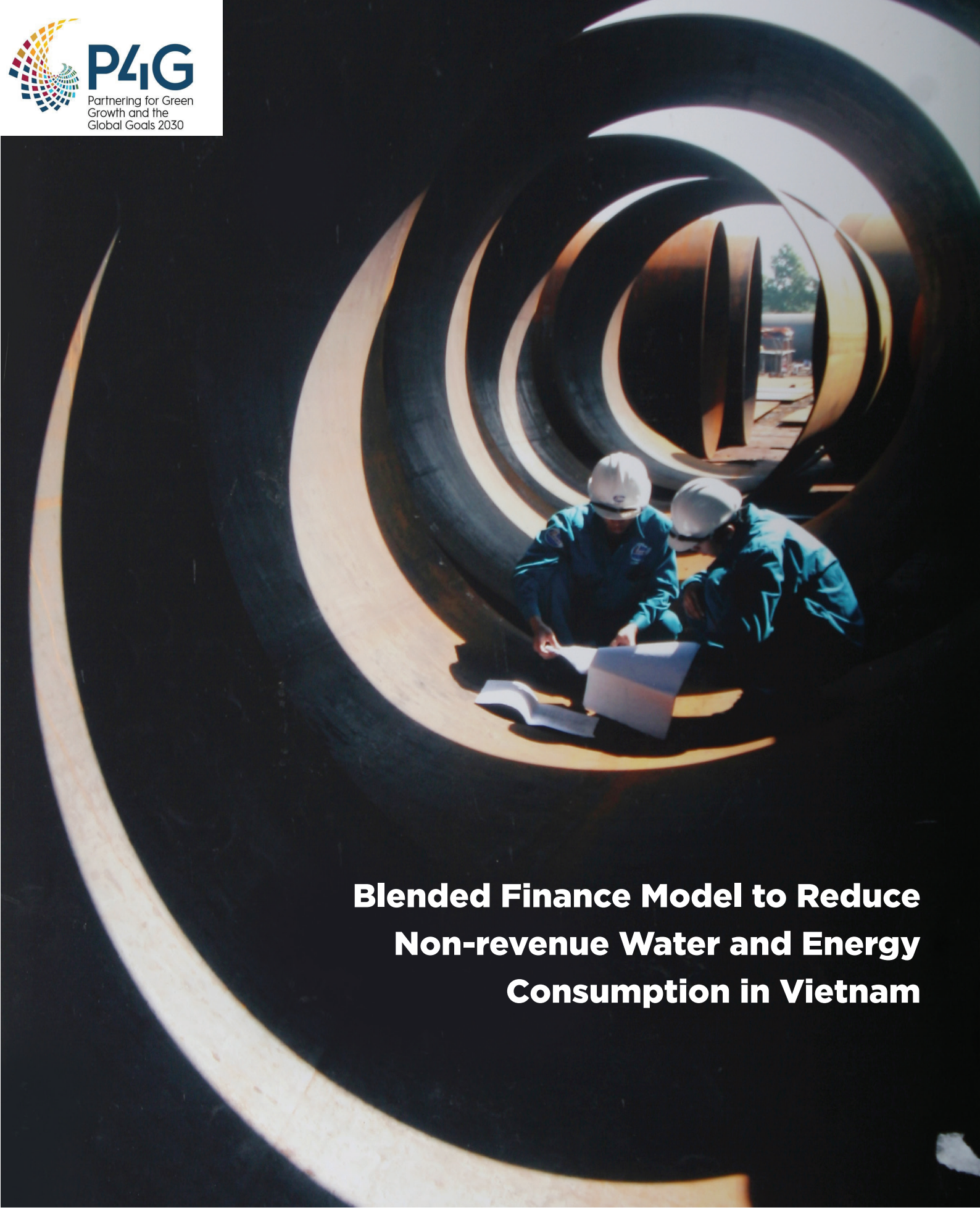
P4G
Partnering for Green Growth and the Global Goals 2030



Blended Finance Model to Reduce Non-revenue Water and Energy Consumption in Vietnam

IFU INVESTMENT FUND FOR DEVELOPING COUNTRIES

GRUNDFOS

ASSIST

VWSA
HỘI CẤP THOÁT NƯỚC VIỆT NAM

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ADB	Asian Development Bank
ASEAN	Associations of Southeast Asian Nations
ASSIST	Asia Society for Social Improvement and Sustainable Transformation (ASSIST Inc.)
ATI	Administration of Technical Infrastructure
CAPEX	Capital Expenditure
IFC	International Finance Corporation
IFU	Investing Fund for Developing Countries
IDA	International Development Association
MOC	Ministry of Construction
MOF	Ministry of Finance
MPI	Ministry of Planning and Investment
NRW	Non-revenue Water
ODA	Official development assistance
P4G	Partnering for Green Growth and the Global Goals
PPC	Provincial People Committee
SDGl	Sustainable Development Goal
VWSA	Vietnam Water Supply and Sewerage Association
WASH	Water Sanitation and Hygiene
WB	World Bank

EXECUTIVE SUMMARY

The World Bank assesses that investment in water infrastructure must triple to US$ 114 billion per year in order to meet the Sustainable Development Goal (SDGs) on water. According to the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water 2017 report, there has been an increase in countries' budget for water, sanitation and hygiene (WASH) at an annual average rate of 4.9% over the last three years. However, 80% of these countries have reported that WASH financing is still insufficient to meet the nationally-defined targets for WASH services (WHO, 2017).

Non-revenue water (NRW) is one of the major challenges affecting water utilities in the developing countries. NRW is the difference between the amount of water flows through distribution system and the amount of water billed to consumers. High volumes of NRW seriously affect the financial viability of water utilities through commercial losses and increased operational costs. The waste of resources resulting from high NRW in developing countries is considerable and furthermore entails a health risk as a leaking network is also in higher risk of contamination. There is a need for strong support with respect to water governance, financial framework, and incentive mechanisms to implement an effective NRW program.

In Vietnam, the rapid urbanization and industrialization in the recent years have led to the significant increase in daily water consumption. In order to meet this increasing water demand over time, an expansion of water supply network is required. Vietnam has a rate of NRW of around 30% in 2009, and the Government of Vietnam has an ambitious target to reduce NRW to 15% by the year 2025 (Geospartial World, 2013).

There is a number of barriers for water utilities to reduce NRW including technical, institutional, and financial barriers. Given an existing lack of financial resources for WASH services as mentioned above, investments from private sector, especially in water infrastructure, are clearly needed. However, the existing private investment in water sector in Vietnam is still limited due to the low water tariffs that discourage the involvement of private sector.

The Asia Society for Social Improvement and Sustainable Transformation (ASSIST), the Vietnam Water Supply and Sewerage Association (VWSA), Investment Fund for Developing Countries (IFU), and Grundfos have expressed interest to collaborate through a partnership, and have successfully applied for an opportunity with Partnering for Green Growth and the Global Goals (P4G) for financial support to develop a blended finance model towards reducing NRW and energy consumption in water distribution networks in Vietnam. This blended finance model, where both public and private investments are part of the financial package, need to be advanced in the coming years.

Outputs from this partnership

Since establishing the partnership, a number of activities have been conducted to support the overall objective of developing a blended finance model, including:

- Develop a framework and contents for the study;
- Perform desk review on Vietnamese water sector;
- Carry out data collection and interviews with officials and financial experts from both the governmental and private sectors on opportunities and challenges in the water sector in Vietnam, existing initiatives, funding schemes, etc.;
- Perform data analysis and desk study for developing the blended finance model;
- Perform assessment of saving potential in the representative water networks in Vietnam;
- Organize workshops with relevant stakeholders for discussing the initial findings and potential ways forward;
- Active participation in the P4G Summit;
- Prepare the study report.

Based on these activities, the partnership has made the key conclusions including:

- Many water utilities in Vietnam struggle to finance large investments following the equitization process, especially as sovereign guarantee of soft loans is not viable for many utilities;
- There are significant opportunities to reduce energy consumption and water leakage in many water networks based on advanced pressure management with relatively limited investments;

- The value of water and energy savings is sufficient to repay the needed investments over a 5- year time horizon in networks with different sizes, thereby the public support is not needed;
- However, when technical conditions do not allow for pressure management and larger investments are needed for installation of new piping etc., there is no business case without some level of grant support;
- Improving pressure management does not need large capital investments, which calls for a bundling mechanism in order to attract large equity investors and keep the administrative burden down in case of grant support.

The partnership has decided to initially focus on optimizing water networks, where there is a business case without grant support, but where risk-sharing can help to scale the impact. This part of the water sector has proven to be much greater in size than anticipated, and therefore the partnership has given priority to it. Following success in this part of the sector, building experience, track-record and proof of concept locally, the partnership expects to be in a significantly better position to finetune the approach to include a grant-element in the financial model.

The partnership has enjoyed support from P4G in different forms, which has been instrumental to bring the partnership to a milestone: Deciding how to best move ahead on realizing the potential in reducing water leakages and energy consumption in Vietnamese water networks. Without support from P4G, the partnership would not have had the same clarity by now, and would not be able to move ahead with the same speed and determination.

The partnership looks forward to continuing the cooperation with P4G to advance the agenda on how to finance the optimization of water networks.

Introduction

Among the SDGs, the SDG6 targets on the universal and equitable access to safe and affordable drinking water for all, improved water quality, increased water-use efficiency across all sectors, and sustainable withdrawals and supply of freshwater to address water scarcity by the year 2030.

NRW is identified as one of the major challenges for water management that many developing countries are now facing. A study performed by the South East Asian Utilities Network (SEAWUN) for analyzing the NRW levels of 47 water utilities across Indonesia, Malaysia, Thailand, the Philippines, and Vietnam reported that the average rate of NRW levels was about 30% (ADB, 2006). The Government of Vietnam has set the target for reducing NRW to 15% by the year 2025 (Prime Minister, Decision No. 2147 dated 24th Nov. 2010).

1. Introduction on water sector in Vietnam

1.1 National policy context

Economic reforms in Vietnam have placed a greater role for the private sector participation as well as shaped the investment trends and needs in the water sector. The water sector was partially privatized in 2007 following the Decision No. 1929/QD-TTg dated 20th Nov 2009 of the Prime Minister, and then reconfirmed by the Decision No. 2502 dated 22nd Dec. 2016. Furthermore, Vietnam has introduced a framework of specific strategies for water resource management (FAO, 2012) including the Water Vision for 2025 and the National Rural Water Supply and Sanitation Strategy which further promotes the role of private sector in providing the financial sources for investment in the water sector (ODI, 2015).

Recently, the Government of Vietnam has approved a National Action Plan to Implement the 2030 Agenda for Sustainable Development by the Decision No. 622/QĐ-TTg dated May 10th 2017 of the Prime Minister. The plan includes targets and indicators established for SDG6 for the two periods of 2017-2020 and 2021-2030. In addition, the Government of Vietnam approved the National Green Growth Strategy for the period of 2011-2020, with a vision to 2050 by the Decision No. 1393/QĐ-TTg dated Sep 25th 2012 of the Prime Minister. Water use, infrastructure for irrigation and water, urbanization, water supply and sanitation are topics of interest within the strategy.

1.2 Water sector overview

The key statistics of the water sector and an overview on the demographic and water coverage indicators in Vietnam are summarized in Table 1.

Table 1: Vietnam water balance

Country information		Year	Value	Unit
Country total area		2014	33,097,000	ha
Cultivated area (arable land + permanent crops)		2014	10,232,000	ha
Total population		2016	92.70	million
GDP		2016	202.62	Billion USD
Per capita GDP		2016	2,186	USD
Renewable Fresh Water Resources	Surface water	2014	847.70	Billion m^3
	Ground water	2014	71.42	Billion m^3
	Rain water	2014	602.70	Billion m^3
	Total	2014	884.10	Billion m^3
Total Annual Freshwater Withdrawals		2005	81.86	Billion m^3
Annual Freshwater Withdrawals by Sectors:	Agriculture	2005	77.75	Billion m^3
	Municipal (including domestic)	2005	1.21	Billion m^3
	Industry	2005	3.07	Billion m^3

Source: FAO, 2017

According to the Decision No. 1929/QD-TTg dated 20th Nov 2009 of the Prime Minister on approving Orientations for Development of Water Supply in Vietnam's Urban Centers and Industrial Parks up to 2025 and a Vision towards 2050, and has been modified according to the Decision No. 2502 dated 22nd Dec. 2016 the specific objectives and targets including: the coverage of clean water supply services in urban centers would reach 100%, with an average water supply norm of 120 liters/person/day and of quality up to prescribed standards; and the reduction of NRW down to 15% up to the year 2025. The key targets for urban water supply sector in Vietnam during the period of 2015-2025 are summarized in Table 2.

Table 2: Targets for urban water supply development in Vietnam

Target	Urban category	2015	2020	2025
Coverage of clean water supply services (%)	Categories III or higher	90	95	100
	Categories IV	70		
	Categories V	50	80	
Water supply norm (Liters/person/day)	Categories III or higher	120	120	120
	Categories IV	100		
	Categories V	-		
NRW (%)	Categories III or higher	< 25	< 18	< 15
	Categories IV			
	Categories V	< 30	< 25	

1.3 Current NRW status in Vietnam

According to World Bank (2006), physical water losses and commercial losses can be valued using the marginal cost of water and the average tariff, respectively. For developing countries, US$ 0.20 and US$ 0.25 were used for the marginal cost and average tariff, respectively. It has been noted that commercial water losses in developing countries estimated at US$ 2.6 billion annually. This commercial loss is likely from the fraudulent activities and corruptions such as illegal connections, inaccurate meter readings, etc. These causes should be of a great concern for both the governments and donors. The NRW levels reported for several cities/provinces in Vietnam are summarized in Table 3.

Table 3: NRW levels reported for several cities/provinces in Vietnam

Cities/provinces	NRW
Ha Noi	23%
Hai Phong	15%
Hai Duong	17%
Thua Thien Hue	13%
Da Nang	19%
Binh Duong	9%
Ba Ria – Vung Tau	15%
Ho Chi Minh	32%

Source: DIT, 2017

Rated as “less efficient” sector, the excessive NRW was due to a number of factors such as technical loss (leakage) and commercial loss (illegal connections and inaccurate meter reading). In an evaluation study conducted by ADB (2010b), the evaluation results for the improvements in NRW between 2004 and 2007 in several towns showed that the level of NRW was high (about 30%). The evaluation results also showed that the implemented projects did not create enough commitment in sustaining the NRW reduction target (the NRW level was expected to reduce to 15% by 2025). The NRW reduction program in all projects was neither comprehensive nor sustained. It has been shown that NRW reduction efforts cannot be sustained through only training, replacement of pipes and meters, and acquisition of complicated leak detection equipment.

1.4 Energy consumption related to water distribution

According to World Bank (2012), the overall energy efficiency of water distribution systems can be indicated by the electricity use per unit of water delivered to end-users (kWh/m3 water). However applying this indicator for evaluating energy efficiency may have two main challenges: (1) mismatch of energy and water flow data, and (2) incomparable operating conditions and processing technologies among utilities. When end-use metering is not universal, oftentimes energy use per unit of produced water is used as an indicator but it leaves out an important efficiency factor: physical losses in the distribution network. In addition, the indicator is significantly affected by processing technologies and operational conditions such as daily flow, mix of water sources or the use of gravity for distribution, etc.

Pumping for water distribution dominates the use of energy which accounting for 70-80 % or more of the overall electricity consumption (World Bank, 2012). The remaining of electricity consumption is used for raw water pumping and treatment process. Groundwater-based supply systems require more energy than surface water-based systems due to the higher pumping needs to extract water. Meanwhile, groundwater usually requires less treatment than surface water, thus requires less electricity consumption. Reducing NRW can help to reduce the amount of losses and prevent excessive energy consumption.

At present, the formal and frequent data collection activities on energy consumption related to water distribution are still limited in most developing countries, including Vietnam. Among the few cases, during the preparation for “Energy Efficiency for Ho Chi Minh City Water Supply Project”, Saigon Water Corporation (SAWACO) conducted an energy audit of its operations. The energy audit report showed that the investment of about US$ 5 million would result in the energy savings of 25,000 megawatt-hours per year, translating to about US$ 1.3 million per year and an annual carbon dioxide (CO2) reduction of about 18,889 tons. Following the audit results, SAWACO has invested in some energy efficient components, especially to equip the treated water pumps with variable-speed drive (VSD). By applying this technology, it is expected that NRW will be reduced to 25% by 2020 compared to the 2010 baseline of 40% (ADB, 2013).

2. Investment trends and programs in water sector in Vietnam

2.1 Investment trends and estimated investment needs in water sector

There has been a decline in the governmental funding on water-related activities as a proportion of the overall national budget (FAO, 2012). During the period of 2002-2011, the Government of Vietnam invested an average amount of US$ 1,140 million per year on water related programs, including infrastructure projects, which accounting for 10.2% of the total governmental expenditure (UNWater, 2013) as shown in Table 4. The largest expenditure (50.6%) was for hydroelectric power plants, followed by those for basic water supply and basic sanitation, and water supply and sanitation in large systems (27.8%). With respect to official development assistance (ODA) disbursements, different investment priorities were seen with the largest amount (33.5%) for water supply and sanitation.

Table 4: Governmental expenditure and ODA in the water sector in Vietnam during the period of 2002-2011

No.	Sub-sector	Annual average governmental expenditure (million constant 2010 US$)*	In percentage (%)	Annual average ODA gross disbursements (million constant 2010 US$)	In percentage (%)
1	Hydroelectric power plants	577.63	50.6	29.54	12.3
2	Agricultural water resources	197.54	17.3	37.29	15.5
3	Basic drinking water supply and basic sanitation	172.12	15.1	31.92	13.3
4	Water supply and sanitation in large systems	144.97	12.7	80.54	33.5
5	Disaster prevention and preparedness	31.00	2.7	24.36	10.1
6	Water resources policy and administrative management	11.15	1.0	12.79	5.3
7	Water resources protection	6.16	0.6	9.02	3.7
8	River development	0.00	0.0	15.06	6.3
	Total annual average	1140.57	100	240.52	100

(*) Governmental expenditure includes some ODA. It has not been possible to separate funds from governmental sources and ODA.

Source: UN-Water, 2013

2.2 Main sources of investment in the water sector

Public financing has dominated the water sector in Vietnam historically. However, the recent policies have put an emphasis on the role of private capital to meet the investment needs given the increasing public debt and competing investment demands. This change is also deemed to be necessary as Vietnam has moved into the category of middle-income countries. As a result, ODA is foreseen to decrease in the future, and that leads to a great concern on the effectiveness in the mobilization of private investment in the water sector.

There have been three main sources of investment funds in infrastructure which divided relatively equally: Government (28%), private sector (35%), and ODA (37%) (ERIA, 2014) as shown in Table 5. Apart from domestic enterprises who play the role as private investors in the water sector, external funding sources come from the Asian Development Bank (ADB), the World Bank (WB), the Japan International Cooperation Agency (JICA), and the French Development Agency, along with the Government of Finland, Denmark, Netherlands, and South Korea (ERIA, 2014).

There is a transition from the high reliance on public investment to some degree of private investment. With the increasing public debt and competing investment demands, state-owned enterprises have gradually moved to new forms of private operation and management. There have been various models of public-private partnerships, equitization, privatization and socialization.

Table 5: Investment programs in water sector

Description	Total cost (US$ million)				
	Period			Proposed allocation	
	2010-2015	2016-2020	2021-2025	ODA	State
Awareness raising for communities	5.2	3.8	2.3	5.0	6.3
Capacity building for water supply companies & local government	1.8	1.3	0.7	2.3	1.5
NRW projects	230.0	164.0	98.0	492.0	
Program management	0.3	0.3	0.3		
Grant total	237.3	169.4	101.3	499.3	8.7

Source: ADB, 2010a

2.3 Equitization and public-private partnerships

The process of equitization involves the transition of a state-owned enterprise into a joint stock company by selling equity to one or more private investors. The purpose of this process is to encourage private capital into the water supply or sanitation sector, opening opportunities and reserving public capital to use for other purposes. According to The Technical Infrastructure Department's report funded by the World Bank shows that by 2016, there were 96 out of 111 water companies are privatized. The remaining 15 water companies (Company Limited) is under the privatization progress till 2020 as per Decision 1232 of the Prime Minister. Most of the equity capital coming from the private sector into equitized firms in the water sector is of Vietnamese origin (domestic private finance).

The governmental policy on equitization varies by sectors. Particularly for the water supply and sanitation sector, the Government pegged a target to continue to hold about 51-65% of the share capital in equitized companies (ODI, 2015). There has been a number of challenges presented by the equitization transition including difficulties for private investors to work with the Government as a compulsory business partner (World Bank, 2014a). The other challenges include the uncertainty in regulatory and policy framework to supervise future operations, criteria in choosing equitization investors, and the demand of substantial price increase in the future to put investment back on track. The dilemma is that in the event that there is some unexpected operating failures on the service, private investors may consider leaving the industry and placing the resolution of operational problems back on the Government.

The process of creating public-private partnerships (PPPs) has been used far less than the process of equitization in the water sector. Establishing a PPP places more demands on private investors in terms of specific performance and behavioral obligations (World Bank, 2014a).

Utilities, particularly state-owned companies, PPPs, and equitized companies, could borrow directly from financial markets through loans or sale of bonds. However, this form of financing has not been used much in Vietnam since the investment risk remains too high and the investors would prefer to see state guarantees for payments. It is difficult for most water companies to access commercial finance as ODI explains in the report of World Bank (2014b): *"There is limited access to domestic or international debt finance within the sector. Although concessional finance and guarantees are available to public and private investors for the development of water supply and domestic solid waste facilities, these are provided only through Vietnam Development Bank's specific pilot credit lines, which are supported by donor finance rather than by the commercial banking sector".*

2.4 Water tariff

Water tariff levels are currently determined by the Provincial People's Committee, based on the guidance and framework provided by the Ministry of Finance (MOF). For examples, the water tariffs for Hanoi and Ho Chi Minh City are shown in Table 6 and Table 7, respectively. The Decree No. 117/2007/ND-CP dated 11 July 2007 of the Prime Minister provides the guideline on production, supply and consumption of clean water. Particularly, the Article 51 of the Decree provides the principles for the calculation of water prices, and the Article 52 of the Decree prescribes the grounds for the formulation and adjustment of water prices.

Table 6: Water tariff for Hanoi City

Water consumption (m3 /month)	Price after 10/2013 (VND/m3)	Price after 10/2014 (VND/m3)	Price after 10/2015 (VND/m3)
Households			
The first 10 m3	4,172	5,020	5,973
From 10 to 20m3	4,930	5,930	7,052
From 20 to 30m3	6,068	7,313	8,669
Above 30m3	10,619	13,377	15,929
Other users (constant price per m3 for all units consumed)			
Administrative and public organization/units	6,540	8,381	9,955
Material production	7,668	9,796	11,615
Businesses and service units	14,137	18,342	22,068

Source: Decision No. 38/2013/QD-UBND and Decision No. 39/2013/QD-UBND

Table 7: Water tariff for Ho Chi Minh City

Water consumption (m3 /month)	Price after 10/2013 (VND/m3)	Price after 10/2014 (VND/m3)	Price after 10/2015 (VND/m3)
Households			
The first 4 m3/person	4,400	4,800	5,300
From 4 to 6m3/person	8,300	9,200	10,200
Above 6 m3/person	10,500	11,000	11,400
Above 30m3	10,619	13,377	15,929
Other users (constant price per m3 for all units consumed)			
Administrative and public organization/units	8,100	9,300	10,300
Material production	7,400	8,200	9,600
Businesses and service units	13,500	15,200	16,900

Source: Decision No. 103/2009/QD-UBND and Decision No. 24/2016/QD-UBND

Vietnam has relatively low prices and tariffs for water-related services and this generates low revenues across the water sector. According to ADB (2010), these prices are low in relation to the full costs of the services provided; low in relation to prices charged in comparable countries; and low in relation to the willingness to pay. Similarly, World Bank (2014a) reported that the ratio of the approved tariff to the tariff required by the water utility was at 0.87 (privately operated utilities were at 0.94, state-owned utilities were at 0.87, and equitized utilities were at 0.85). There are many supporting evidences show that prices for water supply and wastewater treatment often do not cover the full costs. The local governments will fill the gap of the range indicated by the MOF and that proposed by water utilities to enable the cost recovery.

Given the low tariff and the insufficient revenue to sustain services with appropriate standard, utilities see little incentive to invest in leakage reduction effort. Aside from the below-cost pricing strategy that has been used, Vietnam has also subsidized most of services in the water sector. Additionally, subsidized loans and grants have been provided in rural areas for clean piped water and sanitation facilities. However, there has been no clear aggregate estimate of annual subsidy to water supply and sanitation in Vietnam (World Bank, 2014b; ODI, 2015).

3. Objectives and scope of the study

The overall objective of the study is to develop the innovative blended finance model towards reducing the NRW level and energy consumption in water distribution networks in Vietnam. To achieve the study's objective, the key analyses would be performed as the following:

1. Assessing the pressure management as an approach for reducing water leakages and energy consumption;
2. Assessing the magnitude and nature of different types of barriers for investing in reduction of NRW and energy consumption in water distribution networks;
3. Financial analysis for developing the blended finance model to promote investments in the water sector;
4. Identifying the challenges for implementation of the recommended blended finance model.

In this way, this study can support the achievement of SDG6, SDG7 and other relevant SDGs in Vietnam. The study also provides the recommendations for scaling up the developed blended finance model within Vietnam with the intention to utilize this experience in other countries with similar challenges.

In order to conduct this study, a series of introductory meetings and interviews with officials and experts in the key governmental agencies and organizations have been performed (See Annex A for a list of individuals who participated in the interviews). Those interviews have shown the opportunities and challenges for achieving Vietnam's water goals and provided the basis for developing the blended finance model. The preliminary blended finance model has been presented to a group of invited stakeholders in order to gain their valuable advices and feedbacks for further refinement of the model.

Study activities and results

Based on the study framework developed, we have collaborated with relevant governmental agencies and organizations to collect the necessary information by conducting the questionnaire surveys and interviews. Based on the obtained data, the research team has performed the data analysis and used the key findings for developing the blended finance model that recommended for promoting the investments towards reducing NRW and energy consumption in water distribution systems in Vietnam. The study activities and results are presented in the following sections.

1. Pressure management for reducing water leakages and energy consumption

Benefits of pressure management

Leakages can be reduced in different ways, and a combination of different approaches is often relevant. Among the approaches, pressure management has been proven to be an effective one for reducing the leakage part of NRW, improving energy efficiency, and reducing operation and maintenance costs.

Pressure management can be defined as "the practice of managing system pressures to the optimum levels of service ensuring sufficient and efficient supply to legitimate uses and consumers, while reducing unnecessary or excess pressures, eliminating transients and faulty level controls, all of which cause the distribution system to leak unnecessarily" (Pressure Management Team of the Water Loss Specialist Group of the International Water Association).

Pressure management has a great potential to improve efficiency and alleviate water scarcity concerns. In fact, pressure management is now recognized as the foundation for the optimal management of water supply and distribution systems.

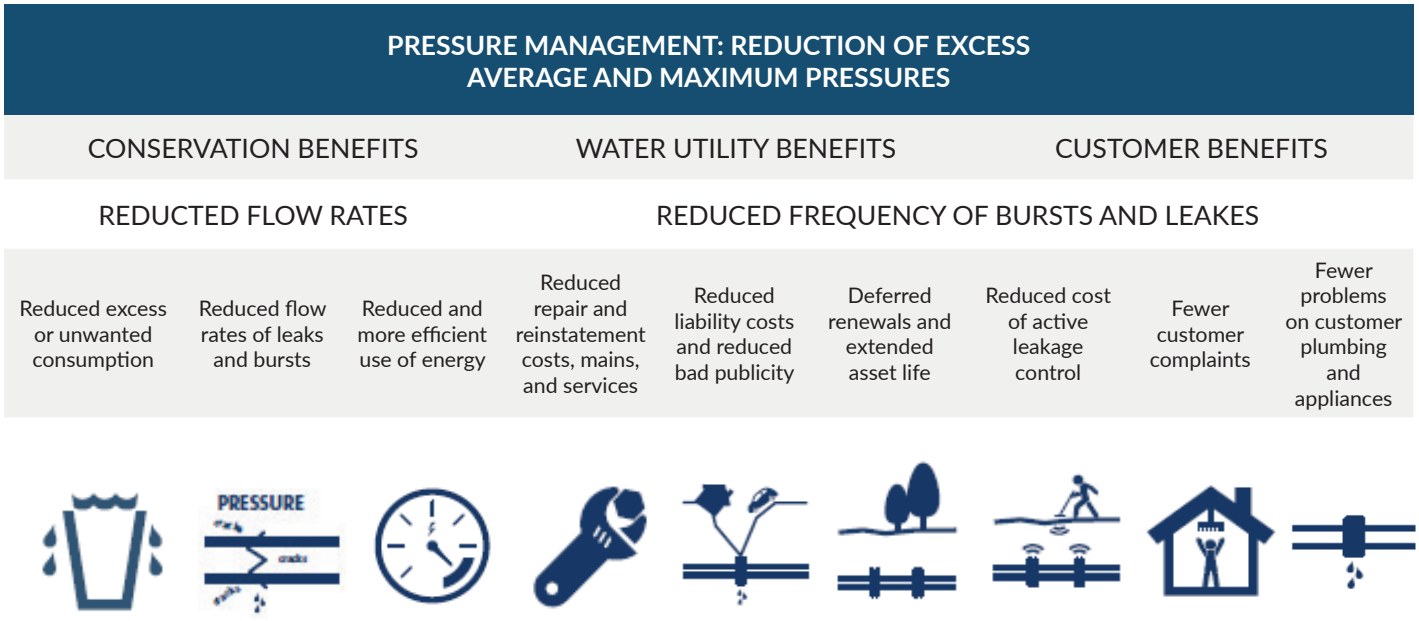

Figure 1: Benefits of pressure management

The key benefits of pressure management are described in Figure 1. The proven benefits of pressure management in distribution systems now include not only the benefits for water conservation by reducing leak flows, but also the benefits for water utility and customer arising from reduced numbers of bursts and leaks. These are, for examples, reduced repair and reinstatement costs, reduced public liability and adverse publicity, reduced costs of active leakage control, deferred infrastructure renewals, and extended asset life of mains and service connections. The benefits also include fewer problems on customer service connections and plumbing systems which leading to fewer customer complaints.

Table 8: Problems and benefits for water utilities' different modes of operation

	PROBLEMS FACING WATER UTILITIES, AND BENEFITS WITH DIFFERENT MODES OF OPERATION		
	INTERMITTENT SUPPLY: (NOT "24/7" OPERATION)	CONTINUOUS SUPPLY: (EXCESS PRESSURE)	OPTIMAL PRESSURE MANAGEMNT: (DEMAND DRIVEN CONTRIBUTION
NRW - HIGH LEAKAGE COMPONENT	Leakage flow rates reduction due to limited time of pressurisation. Very high burst frequencies on mains and services. Big risks of contamination when the pipes are not pressurised.	High burst frequencies due to higher than required maximum pressures for much of the time. High leak flow rates due to higher than required average pressures.	10% reduction of average pressure produces 10% to 20$ reduction in annual leakage (depends on pipe materials and type of leaks)
ENERGY EFFICIENCY	High energy costs for pumping as higher flow rates are imposed to move the same volume.	Excess energy costs due to excess pressurisation from pumping.	10% reduction of excess average pressure produces around 10% decrease in energy costs from pumping.
OPERATION AND MAINTENANCE	High manpower costs for valving operations. High repair costs.	High repair costs High liability costs	10% reduction of average pressure decreases economic intervention costs of active leakage control by 10%.
	Active leakage control is difficult due to insufficient pressure.	Hig active leakage control costs due to higher rate of rise of unreported leaks.	10% reduction of average pressure decreases economic intervation costs of active leakage control by 10%
	Short asset life time due to poor operation and pressure transients.	Short asset life time due to excess pressure.	Deferred renewals, residual asset life extension. This benefit can be very substantial; prediction methodology for pressure reduction being developed.

In conclusion, pressure management is one of the important approaches to improve the operation of water distribution networks. To obtain the best pressure management, the network pressure must be measured and the operation of pumping station should be controlled according to these measurements. Luckily, this is practically possible without the challenges of digging up and replacing pipes.

Assessing saving potential in the existing networks

As described above, there are numerous benefits related to pressure management, and the monetary value of reducing leakages and energy consumption can help cover the needed investments to introduce pressure management to an existing system. But how to assess and validate the potential savings is obviously a key question.

Based on a thorough technical audit of an existing network including pressure measurement, energy consumption, flow rates, operation history, etc., it is possible to calculate the performance of an optimized system. However, proving this in practice is challenging as the performance of system also depends on the fluctuations of external factors such as demand, changes in water sources used for supply, etc.

Therefore, an efficient way forward is to validate the calculation results for a period of one year by comparing with the detailed measurement assuming no significant changes are made to the network during this time. Extending the validation period beyond one year significantly increases the risk of external factors influencing the performance of the optimized system, which makes it impossible to meaningfully compare the performance of the optimized system to the existing one.

In terms of energy saving, the performance of the optimized system can be measured as:

$$\textit{Energy saving} = \frac{\textit{Flow in year 1} * \textit{Head in year 1}}{367 * \textit{efficiency of replaced pump(s)}} - \textit{Energy consumption in year 1}$$

In terms of water saving, the measure is as follows

$$\textit{Lekage reduction} = \textit{Audited leakage} - \left(\frac{\textit{Head in year 1}}{\textit{Audited head}} * \text{Audited leakage}\right)$$

After the first year, the system should obviously be operated so it maintains the same head, and thereby keeps the benefits of pressure management, which is also included in the performancecontract between the project company and the utility even though it is not used to calculate the specific saving compared to the first baseline-year.

Findings from audits in Vietnam

Based on the pressure management approach described above, the saving potential, in terms of water, energy, and cost for four water networks in Vietnam has been assessed:

1. Tri Phuong Water Plant, Bac Ninh's Center for Clean Water and Environmental Sanitation;
2. Quang Tri Town Pump Station, Quang Tri Water Supply Joint Stock Company;
3. Quang Tri River Pump Station, Quang Tri Water Supply Joint Stock Company;
4. Ca Giang Water Plant, Binh Hiep Joint Stock Company.

These networks have been chosen to cover different sizes, locations, and technical set-ups to maximize the learnings for how to structure a financial model. The description of networks and the key findings are shown in the Table 9 below.

Table 9: Assessment of saving potential for four water networks in Vietnam

		Tri Phuong Water Plant	Quang Tri Town Pump Station	Quang Tri River Pump Station	Ca Giang Water Plant
Description	Flow p.a	3.24m m^3	1.3m m^3	n.a	10.3 m^3
	Leakage rate	26%	28%	n.a.*	20%
	Electricity cost (USD/kWh)	0.08 USD	0.07 USD	0.07 USD	0.08 USD
	Water production cost (USD/m^3 lost)	0.35 USD	0.34 USD	n.a.*	0.12 USD
Savings	Water saving p.a.	87,301 m^3	20,985 m^3	n.a	216,390 m^3
	Energy saving p.a.	69,083 kWh	100,981 kWh	235,517 kWh	793,185 kWh
	Cost saving p.a. (water and energy)[1]	36,082 USD	14,203 USD	16,940 USD	89,422 USD
	Costrecovery[2]	Yes	Yes	n.a.**	Yes

[1] Additional savings are likely but site specific, including from O&M costs and ability to invoice more water in a capacity-constrained situation;

[2] Based on a 5-year cost-saving agreement between network owner and contractor;

*The water network was found irrelevant for advanced pressure management in its current state and a water saving thus requires a larger investment in new piping etc.;

** Close call, needs further assessment.

A number of conclusions can be drawn from this assessment:

- The value of water and energy saving is sufficient to repay the needed investments in most cases, however, water saving is important to help finance the needed investments as the existing electricity price is relatively low;
- Even in relatively small networks with leakage rates below 30%, there seems to be a business case in reducing energy consumption and water leakage;
- There seems to be significant economies-of-scale in water intake and treatment based on these examples, as the production cost of water is much lower for the larger networks.

2. Identification of barriers for implementing business models in water sector

According to the feedback from the Vietnamese water sector, some investments have been made in NRW and energy optimization in the past, but with the diminishing ability to finance capital expenditure (CAPEX) investments through public finance or ODA. As a result, utilities today are facing a financing challenge.

As shown in the technical findings above, investments can earn back themselves over a few years in some networks. However, with little or no budget for CAPEX investments and no opportunity for sovereign guarantees behind soft loans, utilities struggle to finance even low-hanging fruits. In other words, even when there is a business case in reducing energy consumption and water leakages without the support of grants, there is still a need to introduce a performance-based business model whereby external private investors can provide the CAPEX-investments needed. Based on this model, a grant element can then be introduced for projects where there is no business case (due to the need for larger investments with longer payback-time for instance).

Based on our expert interview results, the key barriers for implementing viable business models in the water sector in Vietnam are identified in Table 10.

Table 10: Key barriers for implementing business models in water sector

Finance	The provincial governments are responsible for planning and budgeting for water infrastructure in their localities. Projects are then implemented via bid for tender. However, the provincial governments usually do not have the capital, and thus are depended on the funding from the central government and international grants (the latter often requires state-backed guarantees, though).
Private sector participation	Lack of confidence on the sources of future revenue and in regulatory framework to protect the investment. Insufficient incentives to invest in risky and potentially unprofitable ventures, and thus attract fewer investments.
Water tariff levels	Vietnam has comparatively low prices and tariffs for water-related services, and thus generates low revenue across the water sector. The water-related services and tariffs are controlled by the Provincial People Committees. The tariff levels are set to either politically accepted or affordable for consumers, but not feasible in perspective of investments.
Equitization process	The Provincial People Committees who oversee water companies' activities become minority shareholders which means that they lose ability to manage and monitor the water sector. Also, assets in the water sector are slowly sold to private companies and the Government has little involvement in decision-making process. Currently most of investments are based on relationships, and informal contracts are acceptable for the Vietnamese investors but constrained for the international investors.
Institutional coordination	The current coordination strategy is sub-sectoral rather than national; hence there is a risk for the water sector not being invested in locations where needed most or regulatory actions are not promoting policy objectives

Source: Information collected by authors, 2018

3. Analysis of financial instruments for investment in water sector

Financing sources in the water sector include both public finances (governmental funding, grants, etc.) and private finances (donors, etc.). However, governmental financing sources have been restricted recently due to other competing demands such as health care, education, and transportation. Water sector is one of the few generating revenue streams that the Government owns and earns through tariffs. In the context of decreasing governmental finances, private sector becomes an obvious source of assistance, where its involvement can be in different forms, ranging from the long-term PPP arrangements to service contracts.

This also presents opportunities for the water sector to expand its financing by using any surplus generated to borrow money from commercial sources and come up with a weighted cost of borrowing which is a mix of low-cost funding from the Government and market prices from domestic banks. The purpose of this blended finance model is to keep the cost of borrowing affordable. Currently there are not any available public funds for investment in the water sector and that leads to the privatization in the water sector. In addition, co-financing options are usually preferred by the International Development Association (IDA). However, as Vietnam is now moving to the International Bank for Reconstruction and Development term, it means that less ODA is directed to Vietnam and the cost of borrowing is going to be more expensive.

Public private partnership (PPP) model

The new Decree 63/2018/ND-CP (Decree 63) on PPP came into effect since 19 June 2018 has introduced a number of major changes to encourage private sector to invest in PPP projects. The Decree 63 replaces the Decree 15/2015/ND-CP and a number of PPP-related articles in the Decree 136/2015/ND-CP (Decree 136). The key changes of the Decree 63 which highlighted by KPMG (2018) are summarized below:

- **Additional sources of the Government's capital**: The Decree 63 recognizes the additional means from the Government to finance PPP projects such as infrastructure assets, rights to operate construction works or provide services. This gives grants more flexibility to the ministries and Provincial People Committees to mobilize resources for PPP projects.
- **Increased minimum equity requirements for private investors**: Under the Decree 63, the minimum equity requirement for private investors is 20% for PPP projects with total investment capital up to 1,500 billion VND (equivalent to US$ 66 million). For projects with total investment capital of more than 1,500 billion VND, the equity of private investors must account for at least 20% for the capital portion of up to 1,500 billion VND and at least 10% equity for the remaining capital portion exceeding 1,500 billion VND.

- **Decentralization of public finance**: The application of hybrid contracts is under the approval of the relevant ministries and Provincial People Committees, and the approval from the Prime Minister is not required. Ministries also provide guidelines for model PPP project contracts in their respective industries. This aims to increase level of autonomy and accountability of local governments and reduce investment preparations. Local governments are also required to assess their financing position and implementation capacity in applying for financing.

Grants vs loans

The pros and cons analysis for grants and loans are presented in Table 11.

Table 11: Grants vs. loans

	Grants	Loans
PROS	Easy to implement and useful for undeveloped markets or cases where end products are costly for the country	Encourage water companies to apply new financing sources which help them off the "addiction" of low-cost or no cost borrowings
	Useful if grants are provided with links to NRW reduction activities	Reduce costs of borrowings with blended finance option (a mix of public and private finance)
	Provide opportunities for water companies to re-invest in their operational and maintenance structures	Help the Government to target public money for projects with maximum impacts at poorest areas
CONS	Possibilities of having weak commitment from water companies	High interest rates provided by commercial banks
		Higher rate of tariff closed to cost recovery level should be charged to customers

As mentioned earlier, the water tariffs are currently set by the Provincial People Committee based on the Circulars 75 and 100 provided by the 3 Departments and this does not give security to private companies. Ideally, the concessional framework should be in place to set water prices nationally. For example, in the Philippines, the national water tariff is set by the Government which encourages the investment from private sector (e.g. the Manila Water supported by IFC).

4. Case studies on investment in water sector in Vietnam

Sawaco — Manila Water

Recognizing the Government's equitization program is an opportunity for the implementation of PPP project, Manila Water entered in the 2008 performance-based leakage reduction and management services contract for SAWACO Zone 1, Ho Chi Minh City. This project includes 835 km of pipe network and 139,000 connections with high leakage level of 60% before project implementation. As a result of this project, the volume of water saved was 121,621 m3
/day which are three times of savings more than the project target.

Dong Nai Plastic Water JSC (DNP Water JSC)

International Finance Corporation (IFC) has secured a convertible loan of US$ 15.3 million to DNP Water JSC with the aim to provide clean water access for urban households. IFC investment is used to fund the construction of new bulk water treatment plants and the acquisition of privatized water supply companies. The financing package may increase to US$ 24.9 million to support further growth of the company (Vietnam Investment Review, 2018).

5. Recommendation for blended finance model

In order to implement a viable finance model for promoting investment in the water sector, there are key barriers need to be overcome as described earlier:

- Lack of finance – dependence on public or donor funding which can be burdensome;
- Limited precedence for private financing in the water sector due to unclear regulatory framework in some cases;
- Relatively low water tariffs which generate small revenues and discourage investments from private sector;
- Equitization of the water sector – public influence on investment decisions and execution diminishing;
- Financial standing of water utilities do not allow them to borrow funds from commercial bank to invest in financially and environmentally sound projects.

There are also other aspects that a finance model should take into account in order to make it applicable as the following:

- **Minimum administrative burden and simplicity**: The finance model should minimize the burdensome bureaucratic processes that could discourage water utilities and technology providers from using the model. All utilities, irrespective of their in-house capacities, should be able to utilize the finance model, which calls for some level of standardization.
- **Project bundling**: Private investors look for investments of a certain size in order to reduce administration and spread risks. However, for projects with a relatively limited investment size (focus on optimizing and modifying existing infrastructure), investments may only be made if more projects are bundled.
- **Getting the incentives right for all involved stakeholders**: The finance model should address the different relevant criteria that are of importance for all stakeholders involved, i.e. how to ensure a viable business case for project company, in terms of return and risk, when providing a project with the best possible impact; how to ensure that the utilities benefit from the investment from the beginning to incentivize the successful implementation and repayment; how to ensure the alignment with donor policies and requirements?
- **High leverage and maximum impact**: The finance model should ensure the highest possible leverage of donor funding by only providing support at the level that utilities and contractors can establish a business case. That would maximize impact by making room for more investments.
- **Adjustable to fit all**: Where there is a willingness for the investment, the finance model should be developed in the way that can bridge the financial gap regardless of the network size to ensure that water losses could be avoided in all types of network.
- **Scalability/replicability**: The finance model should be developed in the way that it could potentially be scaled and replicated in other types of investments, sectors and/or countries where blended finance is required to ensure commercial viability.

Based on the above analyses, the research team recommends the blended finance model as illustrated in Figure 2.

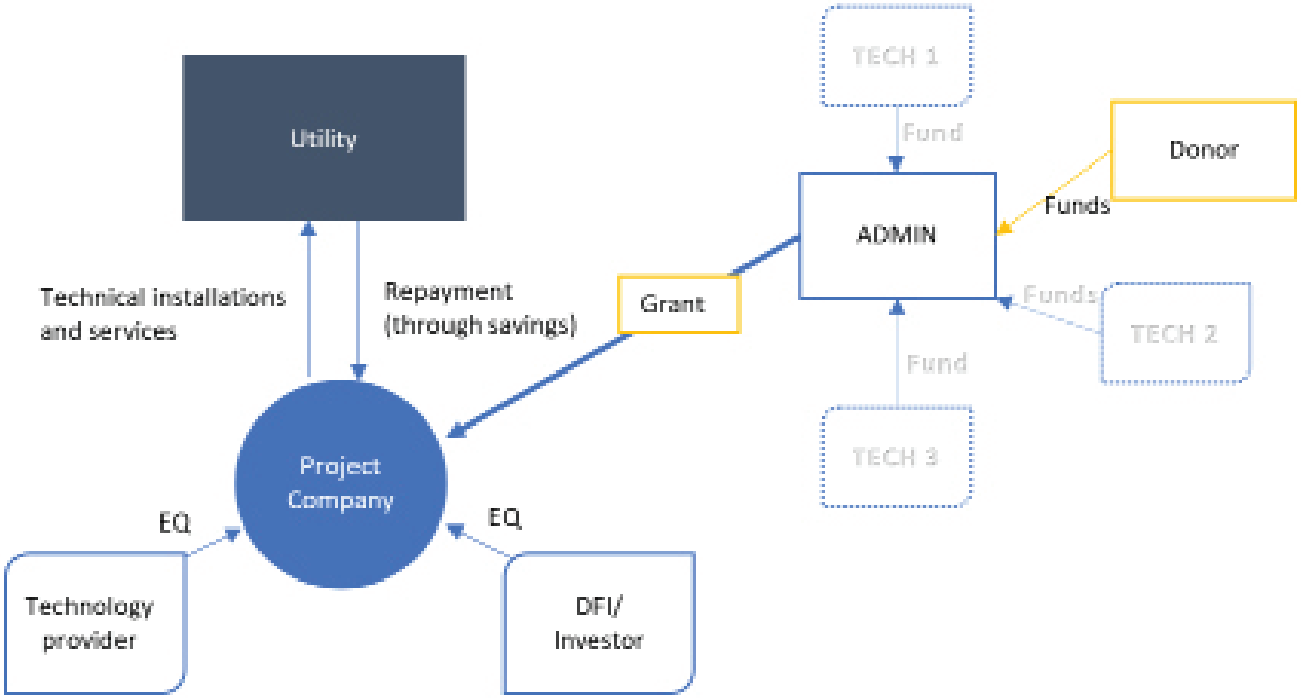

Figure 2: Recommended blended finance model

The roles of different stakeholders in this blended finance model are described as the following::

Project company (Contracting company)

A project company is set up between a technology provider and a development finance institution (DFI) or investor. These partners share the risk on the project, e.g. the customer's ability to pay and the performance of the solution provided. In some cases, the experienced DFI could also bring the knowhow and credibility to the partnership. The project company develops the project and enters into a ***performance-based contract*** with the water utility(-ies) for providing equipment and services with the overall purpose of reducing water loss and energy consumption in water utilities. There is little or no upfront payment, but the utility is obligated to pay for the equipment and services rendered over a pre-defined period (could be 5 years). To some extents, this can be compared to a loan from the project company to the utility with a x-year tenor. The utility's ability to pay does not come from the budget allocated, however, from part of the savings achieved through the implementation of the more advanced technology as well as efficient operation and management.The concept of the performance-based contract is illustrated in Figure 3.

The idea of the performance-based contract in this case is to contract a private company (project company) to implement the NRW reduction program, and the company is paid not only for services rendered but also for meeting contractually enforced operational performance measures. Throughout the year 1, the performance of the system is measured and compared to the utility's old system to determine the savings achieved. The utility then pays a predetermined percentage of these annual savings to the project company for the duration of the contract.

According to the findings presented above, there seems to be opportunities to repay investments with the savings achieved in water networks of different sizes as long as the conditions are suitable for pressure management. This can be done in many different ways and business models and will not need a grant – i.e. the right side of Figure 2 will be irrelevant.

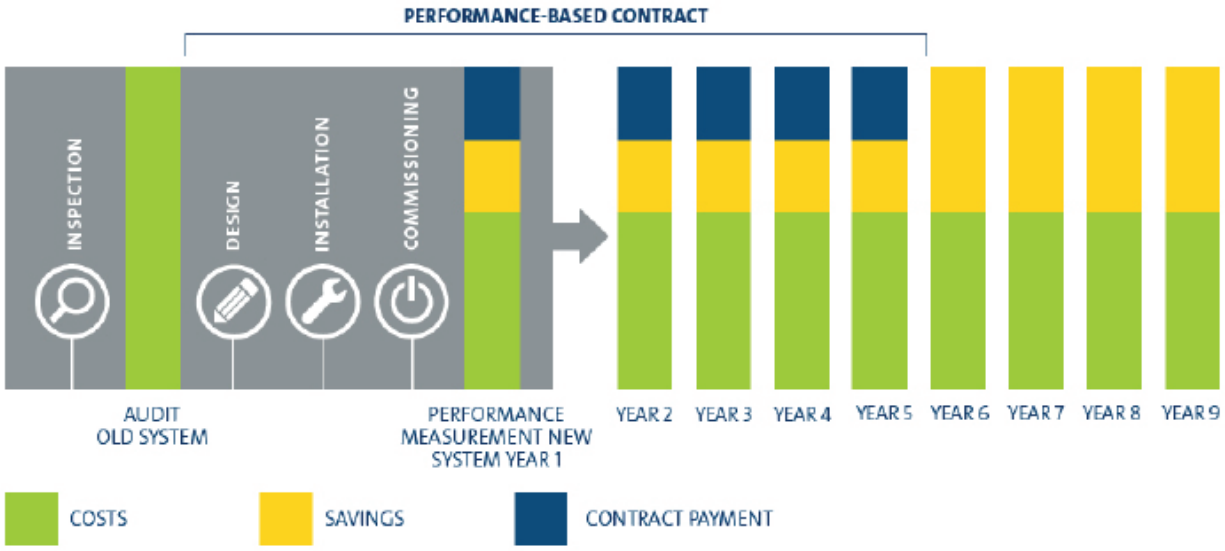

Figure 3: Concept of performance-based contract

However, this will not be the case for all networks – especially if the conditions are not suitable for pressure management and larger investments are needed for piping etc. The administrative processes for acquiring public or donor funding are typically complicated and slow at present. With the equitization process in the water sector in Vietnam, the utilities can no longer rely on public funding. However, with a longer time horizon and/or from a sustainability perspective, the investments could be justified. In this case, to make the investment viable for project company and water utility, a grant or donor funding is needed to fill the financial gap as discussed below.

Grant/donor funding

The purpose of the grant is to bridge the financial gap between the water utility's ability to pay and the minimum required profit margin of the project company. The primary beneficiary of the grant is the utility who will get access to finance for investments in sustainable/advanced technologies and knowhow that they would otherwise not be able to acquire. And they would have to pay a reduced price for the equipment and services equal to the grant compared to the normal competitive pricing. The project company will benefit indirectly as the pool of potential projects where they can ensure an acceptable increased return from their investment. A threshold for the acceptable return from investment should be established to ensure that donor's funding is not utilized to maximize the profit of the project company. This will also ensure that the leverage of donor's funding is maximized. The size of the grant will vary depending on the network size, the magnitude of potential savings, and the other characteristics. To ease and simplify the administration, categories for project should be established and specific grant levels should be tailored for each category.

In order to get the funding from donor, there are typically several requirements for relevant stakeholders, e.g. reporting on results (energy/water savings) achieved and money spent. Providing this information would be the responsibility of the project company, possibly in collaboration with the utility. This set-up would help to reduce the burden for the utility who, in some cases, might have limited capacity

Administrative body (ADMIN)

The grant from international donor(s) or the government/province is provided through an administrative body (ADMIN), a not-for-profit entity established and capitalized by donors and other interested stakeholders, e.g. local sponsors, technology providers, or others. ADMIN would handle the administrative work related to channel of funds, ensure good governance and accountability, proper and timely reporting to donors based on information provided by the project company. ADMIN would channel the funds received from donor(s) to the project company based on an assessment of the needed subsidy to create a viable business case. As the individual investments might be rather small (from donor perspective), ADMIN could pool projects and handle the needed documentation requirements and approval processes of donors. ADMIN would work directly with the project company to follow-up the performance, outcomes and impacts achieved, and report back to donors according to the agreed procedures and requirements. ADMIN could make the wellestablished procedures and guidelines to ease and simplify the approval processes for the project company (and local utility) to acquire the grant.

In the start-up phase, ADMIN could be a donor representative/consultant or other simple set-up until the initiative proceeds to a more mature stage. However, it represents the possibility for scale-up to different sectors/investment types, technology providers, donors/investors, and potentially other countries.

The approach suggested here can be seen as a bottom-up approach where project developer does not sit with the government or donors, however, the project company (or several competing project companies) finds the best possible way forward knowing what kind of public support is available. In this case, this approach is similar to the support models for renewable energy development in many countries, where project private developers initiate projects knowing the level of feed-in-tariff or other kinds of financial support.

6. Identification of future challenges and recommendations

There are several challenges for the successful implementation of the blended finance model recommended in the previous section that need to be further explored and addressed as listed below:

- ***How to create the right incentive structure to ensure willingness to repay from the utilities?*** Savings from reduced NRW and energy consumption are not adequately translated into the higher revenue streams due to the relatively low water tariffs and electricity prices at present in Vietnam. The utility would be still required to repay the project company with fixed share of the savings. It is therefore important that the finance model with performance-based contract is constructed in the way that the utility is incentivized to repay. It could be considered to include either a Deposit, a Guarantee or the like provided by the utility to secure payments to the project company.
- ***How to justify grants to ensure the acceptable profit for private investors?*** Currently energy and water prices are to some degree subsidized in Vietnam. The most optimal solution to ensure viable business cases would be to remove subsidies and introduce cost-based pricing. The blended finance model is sub-optimal in the sense that it circumvents the market failure instead of removing it. Removing subsidies is, however, a very difficult endeavor that would likely be strongly opposed. Blended finance is a way to achieve the targets set by the governments, donors and international society on sustainable development (SDG 6, 7, 9, and 11) in imperfect markets. Also, it could increase the awareness of cutting-edge technology available, and hopefully create a market on commercial terms over time. The grant should benefit the utility directly and not be used to maximize return for the project company. Therefore, a threshold for acceptable return on investment should be established to ensure proper use of donor's funding. It must be further explored how such threshold can be incorporated in the finance model for determining the required grant for each investment.
- ***How to quantify the required grant level?*** It needs to be further explored how the grant could be quantified to strike a balance between donor requirements, commercial viability and minimum bureaucratic processes. The individual investments might be rather small-scale and heavy burdens from documentation and approval processes that might discourage utilities and project

companies/investors from using the facility. On the other hand, donors might be reluctant to provide funding if there is a concern that grants are used to maximize the commercial profit instead of benefitting the local utility. Preferably, projects and consequently grants, could be categorized based on specific characteristics, e.g. network size, performance measures, and others, to ease and speed the administrative processes.

- ***What is the investment ability and appetite amongst utilities?*** Further investigation and dialogue with potential utilities are needed to document the potential for scalability.
- ***What are the best performance measures?*** Realized water and energy savings are obvious performance measures and should be quantified – at least through calculations where the preconditions are continuously monitored (especially pressure in the network). However, the other measures could be relevant, from both the donor and commercial perspectives, when defining the performance-based contract. It is important that a baseline is established to ensure the credibility of results.
- ***How big should the potential saving be for utilities to secure interest in the concept?*** It should be further elaborated how the pay-through-saving model can be defined to ensure that the utilities are adequately incentivized to engage in these types of investments under the blended finance setup. The relatively low water and energy prices may skew incentives for the utilities to maintain and develop their water facilities. It is crucial that the pay-through saving model overcomes this obstacle.
- ***How to ensure a shared incentive between utility and contractor on improving performance?*** Grants would be tied to the expectations on the best possible performance and impact. Utility and contractor (project company) share the wish for demonstrating the best possible use of modern technology. However, they might have other concerns, such as commercial viability, that to a certain extent outrank the sustainability impact. This issue should be addressed in the performance-based contract and blended finance model.
- ***Donor's other concerns?*** There might be other concerns from the donor perspective that needs to be considered and built into the model. Further discussions with potential donors on the blended finance model should be initiated.
- ***Administrative framework***. To ensure that the blended finance model and underlying agreements are in compliance with the Vietnamese laws/regulations, and do not create unforeseen financial effects, external advice should be obtained in order to decide the best location of project company and admin entity.

7. Conclusions

In this study, the research team has implemented the major activities including reviewing on water sector in Vietnam; conducting consultations with different governmental agencies and organization; evaluating the pressure management as an important approach for reducing water leakages and energy consumption in water distribution networks; and assessing the saving potential for selected water networks in Vietnam. Based on these activities, the key conclusions have been made including:

- Many water utilities in Vietnam struggle to finance large investments following the equitization process, especially as sovereign guarantee of soft loans is not viable for many utilities;
- There are significant opportunities to reduce energy consumption and water leakage in many water networks based on advanced pressure management with relatively limited investments;
- The value of water and energy savings is sufficient to repay the needed investments over a 5-year time horizon in networks with different sizes, thereby the public support is not needed;
- However, when technical conditions do not allow for pressure management and larger investments are needed for installation of new piping etc., there is no business case without some level of grant support;
- Improving pressure management does not need large capital investments, which calls for a bundling mechanism in order to attract large equity investors and keep the administrative burden down in case of grant support.

In addition, the research team has also identified a number of barriers for implementing the business models in water sector; evaluated financial instruments for investment in water sector; and developed the blended finance model for promoting investments in the water sector in Vietnam. A number of challenges and recommendations for the successful implementation the blended finance model has been also identified.

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Annex A - List of persons participated in the interviews

1. Bill Kingdom – Lead Water and Sanitation Specialist, the World Bank
2. Victoria Rigby Delmon – Senior Counsel Water Supply and Sanitation Global Practice, the World Bank
3. Oliver Behrend – Principal Investment Officer, Infrastructure – International Finance Corporation
4. Nguyen Hong Tien, Vice Chairman cum Secretary – Vietnam Water Supply & Sewerage Association
5. Do Manh Quan, Expert of Drainage & Sewerage and Wastewater Treatment Management Division (Technical Infrastructure Department under Ministry of Construction)

Partnership for Blended Finance on Water

IFU – Investment Fund for Developing Countries

Asia Society for Social Improvement and Sustainable Transformation (ASSIST)

Grundfos

Vietnam Water Supply and Sewerage Association (VWSSA)

The partnership focuses on developing blended finance models to reduce NRW and energy consumption in water distribution networks using effective pressure management and pump replacement. These blended finance models, where both public and private investments are part of the financial package, need to be advanced. The partnership will initially focus on Vietnam and gain learning possibly replicable in other countries.

Sustainable Development Goals
Through its planned actions, this partnership aims to contribute to the United Nations Sustainable Development Goals