

New Business Model of Purchasing Public Service for Wastewater Treatment in the Perspective of Circular Economy

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Introduction

Circular economy (CE) was initially proposed by Kenneth Boulding in 1966 and is officially adopted by Pearce & Turner in 1990. The core concept of CE is ecological economy. CE is referred to redesign the production chain system. The linear economy model of Take-Make-Use disregards the concept of internal recycling and refers environment as a waste repository. Countries of China, the European Union, Japan, Netherland and United Kingdom discover the trend of circular economy, and involve CE into practices of public works. It accelerates the realizations of CE, and there are many new impetuses occurred in governmental strategies and industrial innovations. The main themes of CE are “economy” and “innovation” and commercial enterprises promote CE for co-join the developmental plan with governmental bodies and making business models works as well as making profits.

The Circular Economy Business Model proposed by the EU-sponsored organization Carbon Trust (Figure 1), which classifies seven business models: co-product recovery, re-make, re-condition, access, performance and resource recovery, circular sourcing, etc. These business models



Figure 1 Circular economy business models

Source: Carbon Trust, 2017

Case study

Such business model that emphasizes service performance, it includes an effective usage in cases of government-led public constructions; that allows the government to generate different thoughts in promoting public construction works. While the public-private-partnership (PPP) procurement model is mainly applied for assisting public infrastructure construction projects in many countries around the world. The similarities between PPP-based project and CE business model is the emphasis of performance and service improvements in the sense of cost reduction and sustainability. Government bodies have high motivations to introduce the PPP model in proceeding public construction projects, especially for environmental protections. Cases of implementing CE principles in PPP-based projects is becoming a norm in the Middle East countries. There are many successful cases adopting PPP model in the Middle East in projects of waste-to-energy, waste management and renewable energy sectors. As the Middle East countries begin to fully embrace PPP procurement model in delivering its key energy and infrastructure projects, there is a good opportunity to embrace the CE business model in other sectors. Indeed, PPP procurement model provide an ideal contractual option within which to embed CE principles in large infrastructure and utilities projects (Taqi, November 2017). In Jordan, the water industry is moving from an end-of-pipe approach originated with the linear economic model to the CE model. The circular model in the water industry has shown a strong economic case and all economic sectors adhere to this model appear to be highly desirable (Abu-Ghunmi, September 2016). In Japan, the PPP model is possibly can be applied in proceeding Incineration technology and Waste-to-power schemes in the sense of smoothly the processes of operations and management. The PPP model shown in Figure 2 is now a standardized approach for design, build, and

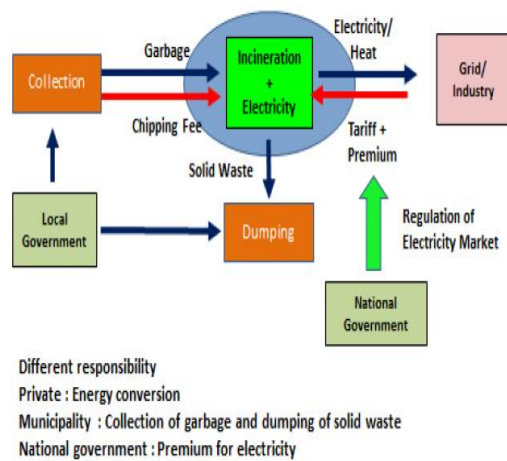


Fig 2 Conceptual PPP model for waste-to-power Scheme in Japan

Source: Hongo, 2016

Successful Delivery of PPP Procurement Model for Sewerage Construction

Taiwan initially adopted the PPP procurement model in 2000 and applied it in proceed sewerage projects with the hope that easing financial burdens to the governmental budget on initial construction and it could effectively improve the wastewater treatment rate. The Sewerage project for Private Finance Initiatives (SPFI), which is one of the major Public-Private Investment Projects led by the Taiwan government, attract vast amount of financial investments from private sectors based on the PFI mechanism (Figure 3). Financial model is the key issue in association with the success of PFI projects. Taiwan government has devised a financial model as the best practice that taking into account of factors as capital structure, repayment mechanism, concession period, and equity internal return rate and so on, while

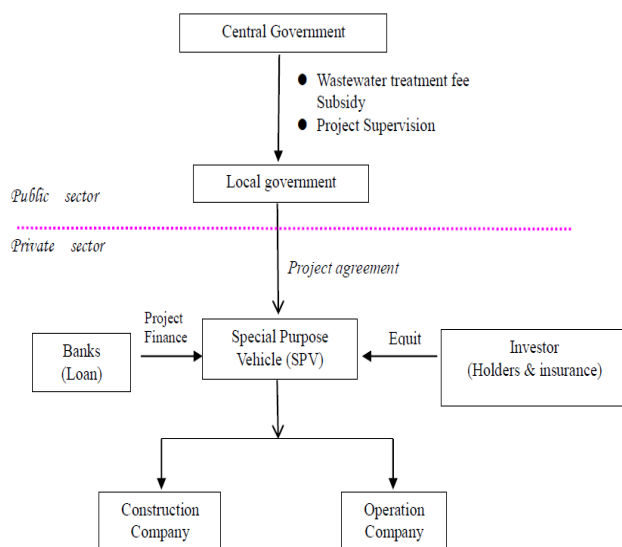


Figure 3 SPFI Schematic Mechanism

The SPFI financial model is well developed with marginal conditions that concession period is fixed to 35 years, Equity IRR equal to 10% and capital structure 30%-70%, capital expense, including construction cost and O&M cost, are calculated separately and repaid to guarantee the concessionaire as a stable income. Although differences exist among financial planning, in principle the contractor recoup their investment from the construction payment, which is calculated based on the designed wastewater capacity and in certain degree offers investment protection to contractors, and from O&M payment (including house-hold connection), which is based on the actual volume of wastewater treated and is able to meet both government policy objectives and contractors risk-spreading principles. SPFIs provide

operate (DBO). For private investors, the PPP model is the energy conversion model where private entities; such as the constructors and operators in an incineration plant with power generation and receives garbage as fuel for electricity generation. Its revenue is retrieved from electricity sales and chipping fees from municipalities. When premium price is given to power from garbage as low-carbon electricity, cash flow from plant operation can be boosted. Waste-to-energy and resources-from-waste schemes contribute to sustainable economic growth and national security by reducing dependence on importing resources. This model should be diffused globally to realize circular economy. (Hongo, 2016)

providing a guaranteeing income to the concessionaire. In turn, there are six sewerage systems that been evaluated as successful SPFIs which were contracted and executed since from 2004 to 2012, and then entered into operation period within four years (Table 1). The SPFI contract combines steps of design, construction, and long-term operation (and maintenance) by a SPV (special purpose vehicle) in the entire concession period. According to construction progress, both wastewater treatment plant and pipeline were completed on schedule, and it only took 3.5 years averagely for those sewerage systems approaching Operation phase in accordance with the expected time schedule. It largely higher the performance and reduce the costs.

adequate incentives to the concessionaire to spur household connection. The concessionaire can benefit through high construction efficiency and skilled sewerage system operation and management. From the perspective of the government, the ultimate objective is to increase household connections, reduce environmental pollution and establish sewerage systems with long service period. Consequently, the concessionaire is being motivated to accelerate the progress of household connections and expected to do their uttermost to achieve high management efficiency and demonstrate their excellent flexibility to maximize benefit. According to the performance in the past years, six SPFIs are successful execution PPP projects since signing contract in 2004. Given the limited budget of the Taiwan government and its pressing goal to establish sewerage systems in the short-term, this proves SPFI is a feasible approach with high performance to the public works. The execution achievement on the Six SPFIs at present phase could be deemed with feasibility in construction as to be a reference to government for future continuous promotion. However, SPFIs will encounter more and more complex management problems and issues, so they need to be kept track and evaluated on a long term basis.

Table 1 The Performance of Sewer PFI Projects in Taiwan

Date by Dec. 31th, 2018

Sewer age system	Date for bidding and Contract	Date for WWTP building		Date for Operation	Performance Evaluation for SPC (Number of Times)		Treatment Capacity (CMD)		Pipe Line Constructed (M)		Household Connected (House)		Wastewater treatment Fee Paid by Government (USD, x10 ³)		Capital Invested by SPV (USD, x10 ³)	
					Numbers of Rank A	% of Rank A	Actual completion	Estimated on master plan	Actual completion	Estimated on master plan	Actual completion	Estimated on master plan	Actual completion	Estimated on master plan	Actual completion	Estimated on master plan
Nanzih	2004.10.20	2009.6.22		2009.12.31	16	100%	26,901	18,535	123,155	124,525	40,490	26,501	167,426	240,523	161,447	262,627
Tamsui	2005.5.31	Phase I 2007.10.31	Phase II 2016.4.29	2008.8.15	19	100%	39,890	49,680	52,705	46,000	77,068	56,763	85,750	117,497	158,886	149,193
Lodong	2005.12.13	Phase I 2009.6.25	Phase II 2012.12.18	2009.6.26	17	100%	26,100	38,856	105,913	80,328	30,695	33,709	74,984	69,968	94,302	130,391
Zhunan-Toufen	2009.3.24	2012.8.8		2012.8.23	10	56%	9,974	21,803	50,686	75,872	25,131	27,011	31,942	42,446	80,286	104,739
Yanshui	2012.11.2	2016.6.23		2017.1.26	6	60%	2,992	21,956	39,647	46,349	8,759	17,500	8,329	13,851	60,727	80,082
Taoyuan	2012.10.29	2015.10.29		2016.1.28	11	100%	30,200	33,576	74,358	108,287	66,602	25,080	25,579	37,542	210,450	223,015

Conclusions

Taipei City government are aiming to improve the efficiency of materials and energy use. This strategy, Circular Taipei-An Action Plan for the Circular Economy (CE), is the main innovative industries policy announced by Taipei government in 2018. Base on the Concept of Circular Taipei, Taipei city government has produced rich practical Actions including water, Energy, Food, Waste and Mobility which in regard with the CE from its fundamental concept to its practical implementation. Since six Taiwan's existing domestic wastewater treatment systems built by PPP model have made a good performance as a new CE business model. Successful enforcement of a CE is contracted for service performance instead of assets possessing. Although Taipei city has more complicated situations different from other cities in Taiwan. However, in the near future, The PPP model may strongly be recommend to be a master plan for improving Taipei domestic wastewater system development which regards two existing old wastewater treatment plants and two new water reclaimed plants.

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3. Diana Abu-Ghunmi, Lina Abu Ghunmi, Bassam Kayal, Adel Bino, "Circular economy and the opportunity cost of not 'closing the loop' of water industry: the case of Jordan", November 2016
4. Hongo, T. (2016), "Circular Economy Potential and Public-Private Partnership Models in Japan", in Anbumozhi, V. and J. Kim (eds.), *Towards a Circular Economy: Corporate Management and Policy Pathways*. ERIA Research Project Report 2014-44, Jakarta: ERIA, pp.17-29.