



Findings and lessons on policies and cost recovery of basic SWM and WtE

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Basic service of Municipal SWM include



Collect MSW at HH and entities



Transfer MSW, informal 3R or scavenging



* Simple recycling, composting/digestion



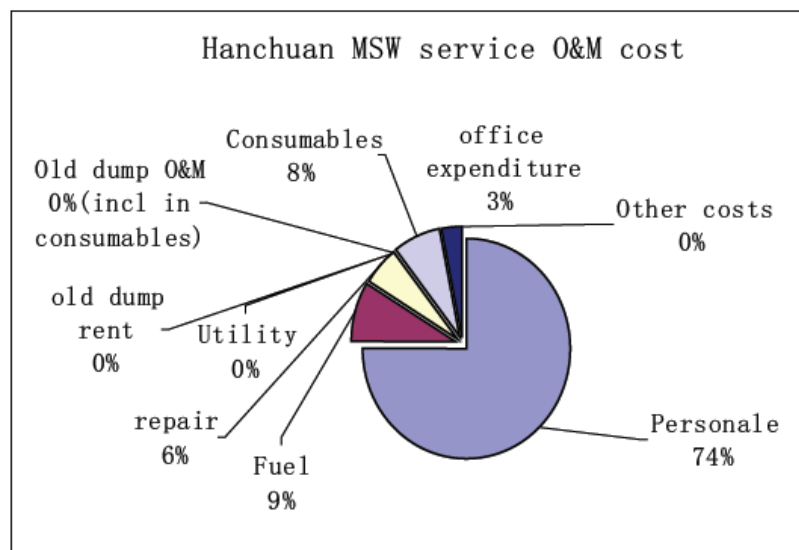
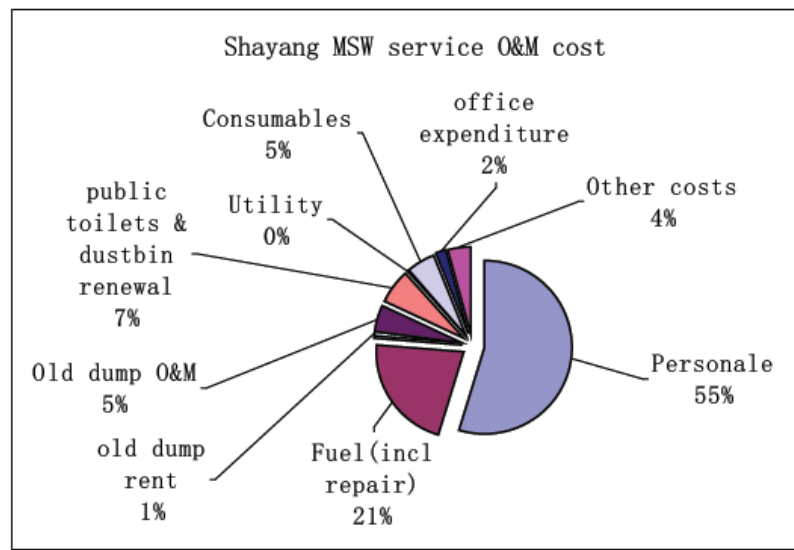
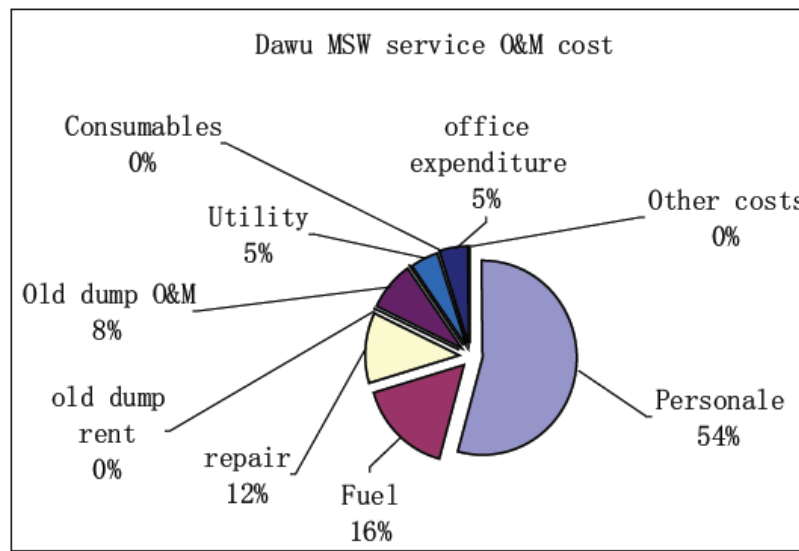
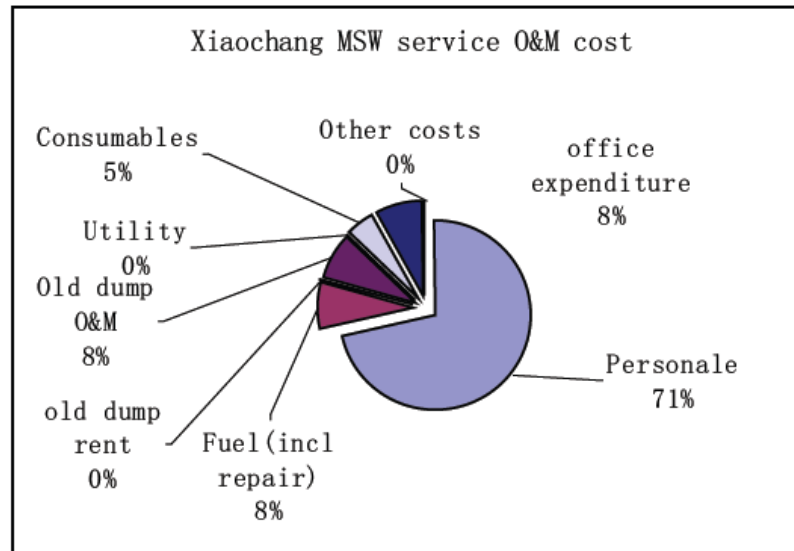
Disposal at (sanitary) landfill

Cost recovery: biggest challenge for SWM in DMCs

Conclusions of our study on “cost recovery of MSWM in small cities of inland China”

(by Xin Ren and Shunong Hu, *Waste Management & Research*, 2014, Vol. 32(4) 340–347):

- Both capital investment (hauling fleet, new landfill, and transfer stations built, including loan interest) and their depreciation are shouldered by local gov. Only O&M cost by SWM service.
- **Cost recovery by user fee is 16-45% in our study**, even if they only cover O&M cost. Countrywide, user fees collected typically **covers 20–50%** of the total MSW cost in China (other studies)
- User fees better serve as 3R incentive than for cost recovery. Such a shift has implications on, e.g. design of cost recovery mechanism, performance criteria or service outsourcing.
- local gov needs first to improve cost efficiency of MSW services: by PPP /privatizing. BUT:
- Financial Transparency: need to disclose Breakdown of all O&M cost and revenue each year. Or, the public can mistrust gov to squander their money by careless SWM or PPP deals.



1. The biggest cost is labor, 50+% to around 70% (higher in OECD countries), as basic SWM service is labor-intensive
2. The second biggest cost is on fuel, repair of vehicle and equipment.
3. Confirmed other studies: population density, MSW amount, service area, geometric design of street, are key factors for cost.

≈ 2. Distribution of O&M cost of MSW service in four cities.

Table 2. Comparison of MSW generation rate (kg/capita/day).

Studied cities	Beijing	Shanghai	Wuhan	Mid income	EAP
1.12–1.3	0.86 ^a /1.13 (2007) ^b	0.82 ^a /0.93 (2011) ^b	1.01 (2010) ^b	0.78–1.161 ^c	0.95 ^c

^aData from China Statistical Yearbook (2011).

^bCollected MSW from the latest media reports divided by urban population from China Statistical Yearbook of that year.

^cAverage MSW generation of countries in EAP region and of mid-income countries in the world, from the World Bank 2012 study.

EAP: East Asia and Pacific.

Table 3. Latest MSW composition (in wet weight, %).

County	Kitchen organic	Coal ash and debris	Plastic	Paper	Metal	Glass	Rags	Other	Remarks ^a
Shayang	48	36	6	3	2	2	1	2	Update in 2011
Dawu	39	30	6.5	3	2	2	3	14.5 ^b	Update in 2012
Xiaochang	23	65	3	2	1	1	1	4	2009 FS data
Hanchuan	55	38.5	2	2	1	0.5	—	2	2007 FS data
EAP region	62	NA	13	10	2	3	NA	10	World Bank et al., 2012
L-m income	55	NA	13	10	3	4	NA	15	World Bank et al., 2012
Beijing	63.4	5.9	12.7	11	0.3	1.8	2.5	1.8	Zhang et al., 2010
Shanghai	66.7	2.8	20	4.5	0.3	2.7	1.8	1.2	Zhang et al., 2010
Hangzhou	64.5	15	10.1	6.7	0.3	2	1.2	0.1	Zhuang et al., 2008

^aHanchuan and Xiaochang County carried out waste characterization in 2007 during feasibility study for the WB project and did not update since then. Dawu County updated in 2012 and Shayang in 2011.

^bDawu included construction and demolition (C&D) wastes (14.5%) in total MSW statistics.

EAP: East Asia and Pacific; FS: feasibility study.

MSW trends and implication on SWM strategy

1. Despite data deficiency, some trends in MSW amount and composition are apparent:

- Share of recyclables in small cities MSW is lower than big cities in China, mainly due to economic affluency and more gas use in latter, more household recycling and scavenging in the former.
- The highest share is organic wastes (still 50-70% of MSW in China today), can rise if coal use decrease
- The WB: Middle- and low-income countries generate 53-57% food and organic waste (https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html)

2. Implications on MSWM strategy, esp. DMCs and smaller cities:

- Technology not a panacea, usually only one factor for SWM. Select locally suitable solutions likely succeed
- Organic separation and composting /bio-digestion prioritized over material recycling;
- Given the high ash/dirt and moisture, low caloric value, incineration may NOT be viable.
- Yet, WtE booming in China and has attracted a lot privet sector investment ... WHY?

Why WtE booms in China, but not in other DMCs

1. WtE took off mid-2000 in coastal China due to:

- Rapid economic growth and urban expansion, thus MSW increasing rapidly
- Coupled with land shortage in densely populated area, esp. affluent coastal cities.
- Most important : National policy since 2006 has boosted WtE

2. National policies that matter most for WtE:

- China's 2006 policy for renewable energy (RE) requires the grids to purchase electricity from RE sources including MSW with a premium on prevailing feed-in tariff.
- Electricity sale accounts for 80% of WtE's revenue. 15 years later it changed little: 75%.
- The rest (~ 20%) mainly from tipping fees paid by users and tax rebate.
- However, without the tariff subsidy, most WtEs in China would not earn enough to cover cost, given the prevailing incineration technologies and O&M practices.

Strong effects of RE tariff subsidy to boost WtE

Hefty tariff subsidy has made WtE's profit rate up to about 20% in China, while manufacturing at barely 5%–6%, according to studies

No surprise WtE attracted business interest and PPP in China since then. As result:

WtE now 6-7 times than 2006 and treat 40+% MSW, led to distortions...

OECD countries in Europe have averagely incinerated 27% of MSW and OECD worldwide 22% (WB).

Given the life span of incinerators (30-40 years) and heavy investment, over-capacity soon in China - can burn legacy wastes dumped

Crowding out effects of over-WtE on other SWM options

Incinerators need near full capacity to operate at optimum combustion efficiency—not only for good fuel economy but also for best emission control.

So WtE requires a lot wastes daily, stipulated in BOT contract local gov has to fulfill—they are tied long-term (20–30 years) PPP contracts, implications on local social-economic development?

Recycling, composting etc often forced to stop or disincentivized once WtE is in town: MSW must be sent to WtE to meet the feedstock target.

Even landfill projects in smaller cities affected, since they are asked to send MSW to bigger cities to feed WtE there.

MSW in DMCs esp. unsorted has higher moisture, lower heat value, unsuitable for WtE unless coal or heavy oil is added to aid combustion.

Many WtEs have been doing this, up to 20% capped by China's RE subsidy policy: increased the transaction cost to design and enforce the subsidy policies to ward off free-riding and loopholes.

As a result, WtE in China reduces waste volume by ~70% only, not 90% as in standard incineration, generating twice more slag that must be landfilled.

WtE also Crowding out others in developed countries

- European Union's directive on RE, recast in 2018, **still excludes MSW** except the organic fraction of biological origin (e.g., yard wastes). Unlike China, WtE in EU cannot enjoy RE subsidies etc.
- Nonetheless, some EU countries have subsidized incineration and recycling to divert wastes from landfills, given the landfill bans in many European countries.
- Recycling has succeeded in Scandinavian countries that their expanded incineration become overcapacity.
- Scandinavian countries have highest incineration (about 50%), have to import wastes across Europe.
- Some argue that were it not for overcapacity in incineration, these environmentally conscious countries could have reached higher recycling rates than 30-plus % (e.g. [Germany recycles about 45%](#)).
- Some regions in Europe have wisely **capped the incineration rate** (e.g., at 25% in Flanders) and have seen the combined recycling and composting rate reaching as high as 70%.
- **A study in OECD countries shows once incineration rate above 40%, recycling starts to fall.**

--- <https://development.asia/insight/integrated-planning-and-policy-design-sustainable-waste-management>

Abolish subsidy for WtE? Or ban WtE at all

1. **Some Chinese experts have called for abolishing the tariff subsidy for WtE:**

- Since it has stimulated incinerators' demand for more garbage and expansion but discouraged waste segregation and recycling.
- It is borne by the grid, essentially paid by the central and provincial coffers, not by local gov. thus added their enthusiasm for WtE (perverse incentive).

2. **China's feed-in tariff for RE is 0.65 yuan/kwh currently**


- Beijing's normal feed-in tariff was 0.35 in 2019 (= national average). The premium/subsidy for RE is 0.3 (0.65-0.35), 85% of its normal tariff.
- Guangdong Province has second highest tariff (0.45)= least rely on subsidy, still 44% of its normal tariff.

3. **Recycling and WtE etc complement SWM, but all need landfill as final disposal**

- Wastes cannot be 3Red often incinerated for proper hygienic treatment.
- Fly and bottom ash of incineration still need to be disposed, often landfilled

Calculate WtE's true profit without tariff subsidy

- Assume total revenue is R and cost C (including depreciation) to simplify the calculation:
Net profit rate= $(R - C - \text{tax payable})/C$.
- Incineration in China basically only pays corporate income tax with rate at 25%. Thus:
Tax payable= $(R - C) * 25\%$ (revenue times tax rate).
Net profit rate= $(R - C - (R - C) * 0.25)/C = 0.75 (R - C)/C$.
Now that the net profit rate averages at 20% In China, So: $R = 1.27C$
- **Without tariff subsidy**, revenue from electricity (75% of R) decrease drastically but at various degree due to its share in normal tariff. Ex. of Guangdong (least rely on subsidy):
 - Total revenue: $75\%R * (1 - (0.65 - 0.45)/0.65) + 25\%R = 0.77R = 0.98 C$, barely break even
 - For the rest of China, WtE revenue would shrink deeper, thus won't survive.
 - WtEs hardly succeed overseas except Vietnam etc: worth studying their policies



Ideal level of RE tariff subsidy for WtE depends on policy direction

- Explore the desired subsidy level for net profit rate on par with or slightly higher than manufacturing
- This can also force WtEs to demand drier and “purer” wastes to improve combustion efficiency, in turn adding the push for waste segregation.
- Gradually reducing tariff subsidy will level the ground for other means of SWM to compete with WtE. Or through:
- Proper design of WtE subsidy to minimize distortion: e.g. fixed total tariff, fixed premium, fixed % of premium
- All can reduce the WtE cost by market mechanism, esp. when combined with tech renovation and improved O&M

Integrated SWM planning and its essential components

- 1) Survey the MSW amount, characterization, growth rate and projection for future, as well as climatic, geographic and demographic etc key factors for waste generation and composition.
- 2) Diagnosis of current SWM: collection, transfer, handling, 3R, treatment and disposal;
- 3) Evaluate major technical options (3R, digestion, composting, incineration, landfill etc): requirements and technical capacity, cost to build and operate, environmental-social pros and cons, and GHGs
- 4) Examine the relevant national and local policies **especially economic incentives** at play, which can tip the cost /benefit ratio of the above technical options thus their choice or not.
- 5) Only based on 1)-4), can the ISWM plan be developed and justified, tailored to a city's specifics.

Such plan will serve as roadmap of a combination of 'software' (incentives, subsidy and management practice such as waste segregation) and 'hardware' investment plan for short, medium and long term, such as on landfill, recycling or incineration.

Conventional SWM:

- Small city 150,000 popl, increase ~2%/yr,
- MSW: 0.7kg/person/d
- Existing: basic MSW collection, str. Cleaning, open dumps as disposal
- Tropical, flat terrain, sufficient land in vicinity
- Typical proposal:
build sanitary landfill of design capacity 100t/d and 20 years life span, bins, transfer stations, vehicles etc

Additional under ISWM planning:

- 1) **Characterizing MSW:** organic waste 60% (yard waste 30%, kitchen/oily 30%), recyclables 10% (paper, glass, metals, plastics), ash and dirt 20%, others 10%
- 2) **SWM options catering to MSW composition:**
 - The Biggest share is organic wastes: ~ 60t/d
 - Yard waste (30+t/d): composting HH or municipal? Digestion? Tech? etc
 - Kitchen/oily waste: private sector available? Profitable/attractive to them?
 - Recycling for material: same issues as above
- 3) **Examine policies esp economic incentives affect profit/cost, past initiatives etc**
- 4) **Investment plan better justified:**
 - Composting or digestion facility of 30-40t/d: incl some kitchen residues
 - Recycling: continue by informal sector but improved by simple MSW segregation
 - Sanitary landfill of still 100t/d: can last 20+ years due to diversions above
 - MSW segregated into three: compostable, recyclable and others ----- Crucial for recycling (incl composting/digestion) to succeed is to reduce impurity.

Thank you!