

General Waste Logistics, and Management at the Nanyang Technological University, Yunnan Campus

Patricia Alvina, Ryan Jin Zhanhe, Amirah Nadia Bte Jaafar

I. OBJECTIVE AND BACKGROUND

The objective of this exercise is to understand the waste management system in Nanyang Technological University (NTU) in the Yunnan Campus for the EcoCampus initiative.

The initiative aims to reduce energy, water and waste intensity by 35% in 2020. The NTU visions to be the greenest campus in the world and be the leading example of high impact energy efficiency and sustainability, accentuating innovation and growth. Hence, a better understanding on the current waste management system to identify improvement to be done is critical.

The initiative aims to develop a novel campus-wide sustainability framework with demonstration sites to achieve a 35% reduction in energy, water, and waste intensity by 2020 (baseline 2011).

In the year 2014, three thousand tonnes of waste were collected in the NTU main bin center, located at the Jalan Bahar exit. This equates to 72 kg/capita. In the year 2015, the waste intensity in the Yunnan Campus has decreased by 1% in comparison to 2014 and a total of 20% reduction in waste intensity in accumulated from 2011.

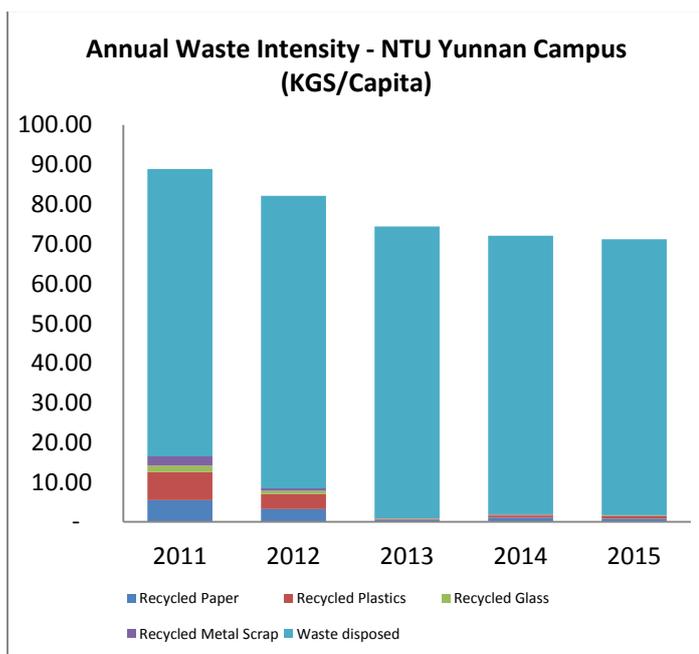


Figure 1: Waste Disposed in NTU from the Year 2011.

The Sustainable Singapore Blueprint 2015 indicates that it will work towards becoming a Zero Waste Nation

by reducing our consumption of, as well as reusing and recycling all materials to give them a second lease of life. The Government, the community and businesses will come together to put in place infrastructure and programs that do this our way of life. The blueprint aim to keep Singapore clean and healthy, conserve precious resources, and free up land that would otherwise have been used for landfills, for our future generations to enjoy.

A public concern for climate change is evidenced by the Paris Agreement on Climate Change agreed by 195 nations during United Nation climate conference (COP21), increased along with the media coverage. The way a problem is presented to the mass can influence people's choices. The content of the message to the mass is critical.

An item is defined as waste when it has served no purpose or render unusable/unwanted by the owner. Recycling and upcycling activities could directly impact the total waste disposed. The waste logistics and management is one component of the entire cycle of waste management.

II. METHODOLOGY

The methods taken to gather data include an interview with the people in charge, on site visits along with observations of how the waste is collected by each contractor. Interviews with the canteen operators were conducted to determine the amount of waste being generated by each canteen/food establishments. The driver from the general waste contractor then interviewed. Site visits were also conducted to determine the type of waste being disposed of in each of the zones. Pictures were taken as reference during site visits.

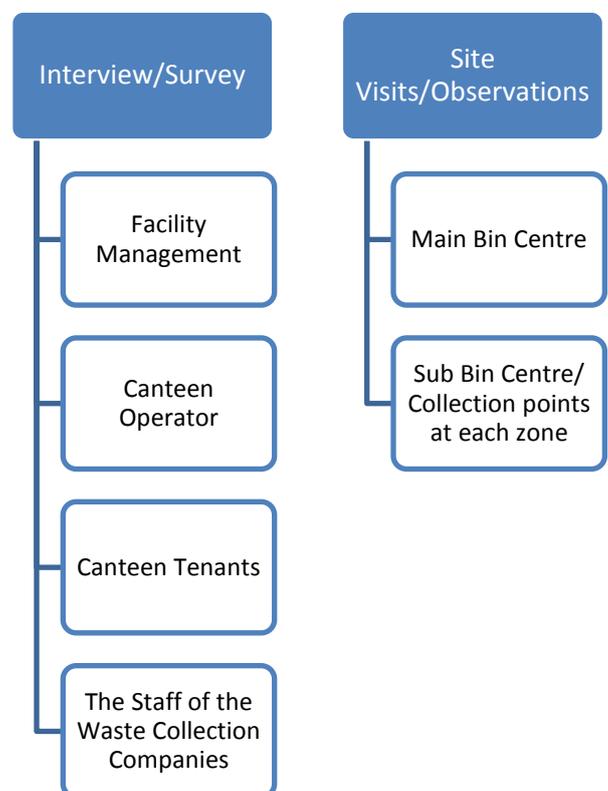


Figure 2: Data Gathering Method and Data Sources

III. FINDINGS

The study found interaction and co-operation in general waste management in NTU, indicated in the Figure 3. The EcoCampus initiative could improve the waste intensity in the NTU campus in 2 ways. First, reduce waste produced by means of social interaction with waste producer. Second, a reduction in the waste disposed through increase waste recycling by social interaction with the recycling entity.

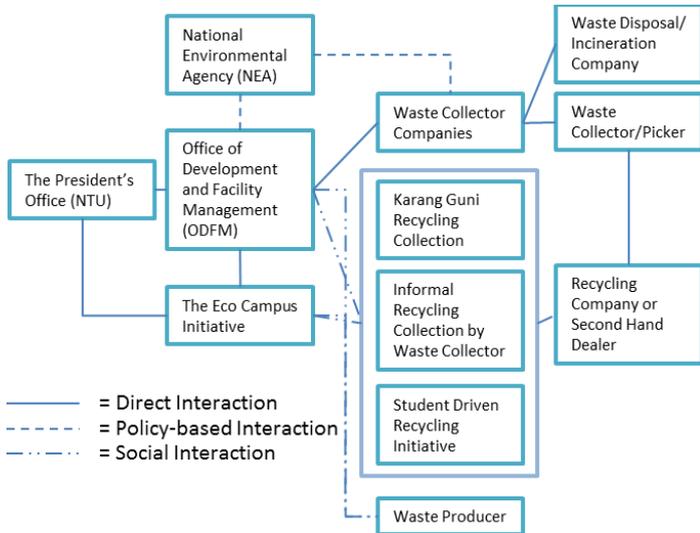


Figure 3: Interaction and co-operation in general waste management in NTU

Table 1 summarizes the stakeholder roles from the point of production to the disposal.

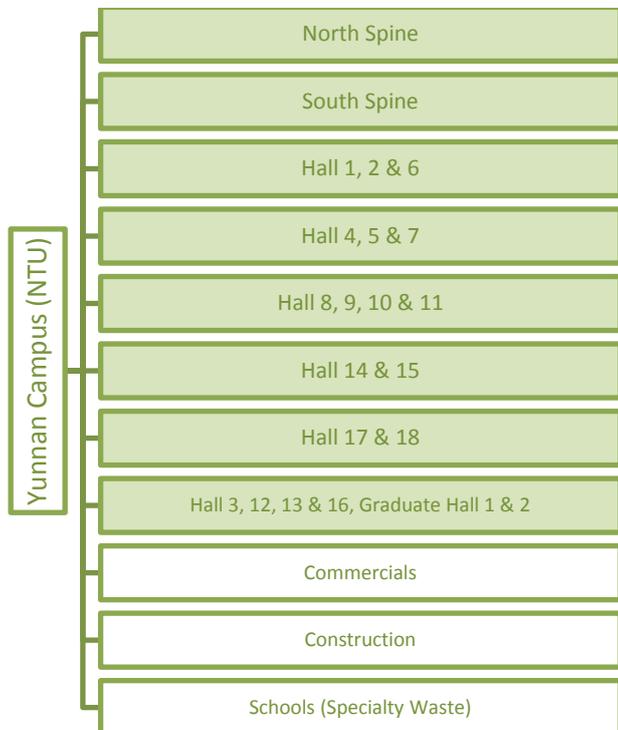


Figure 4: Source/zones of waste collection in Yunnan Campus.

Table 1: Stakeholders Roles Summary

Stakeholders	Roles
EarthlinkNTU/ Student Driven Recycling Initiative	Raise awareness on environmental issues, promoting environmentalism among the NTU community, address climate change in small, achievable and measurable ways.
EcoCampus Initiative	An initiative under the Sustainable Earth Office (SEO) and Energy Research Insititute @ NTU (ERI@N)
Recycling Collection	Collecting the recyclable materials from collection points such as large cardboard boxes and plastic packaging.
National Environmental Agency (NEA)	Plans, develops and manages refuse disposal facilities; licenses waste collectors; regulates refuse collection for the domestic and trade premises in the nine sectors; and enforces illegal dumping. Promotes the 3Rs (reduce, reuse, recycle) conserve resources.
Office of Development and Facilities Management (ODFM)	Appoint a contractor to collect waste in each zone and the disposing the waste from the main bin (i.e. Public Waste Collector) Managing day-to-day activity of the waste contractor. Providing Waste Bin, or other related equipment
Public Waste Collectors	Collect the waste bags from the collection points and transporting it from source to the main bin centre at Jalan Bahar. Segregate Recycled Waste
Students/Staff/Constr uction	Waste producer
Waste Collector Companies	Assigned cleaning staff to collect waste everyday from the multiple dustbins in the building. Collecting the waste from the agreed collection point in each zone and bring to the main bin center in Jalan Bahar.

Waste Collector/Picker	Collecting waste from the dustbins in the building, and bring to the collection point to be carried into the main bin center.
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A further study was conducted to understand the type of waste disposed and possible influence could be made to the waste producer and possible increase in recycling rate.

The Yunnan Campus is divided into zones for the purpose of waste collection. There is a total of 11 zones or source of waste producers. This paper focus on the logistics of the 8 main zones. Figure 4 indicates the zones or sources of waste area.

Site visits were conducted in all zones to understand the process of waste collection.

It was found that the waste collector companies are professional and waste collection was done as scheduled. This results in general high cleanliness across the campus. Table 2 summarized the waste collection time during the site visit.

In addition, recycle collector company was found collecting recyclable from multiple locations in the campus.

Table 2: Collection Points, Zones, and Collection Time

Areas	Collection Time during Survey	No. of Collection Points
North Spine	8:45am	7
South Spine	8:45am	8
Hall 1, 2 & 6	7:45am	8
Hall 4, 5 & 7	8:15am	5
Hall 8, 9, 10 & 11	8:15am	11
Hall 14 & 15	9:15am	9
Hall 17 & 18	8:30am	8
Hall 3, 12, 13 & 16, Graduate Hall 1 & 2	8am	23

Following are finding during the site visits and survey:

1. The general waste could be further segregated at source to reduce/avoid contaminant and potentially increase recyclable waste.
2. There is a lack of clarity in the accuracy of measurement on the type and amount of waste disposed.
3. Food waste may contribute approximately 50% of total general waste disposed in NTU.

The lack of general measurement on the exact type of waste disposed create a challenge to proposed suitable campaign and project to improve waste intensity in the campus. Understanding the waste composition will allow the necessary department to create relevant influencing campaign or project to reduce waste intensity.

IV. CONCLUSION AND RECOMMENDATION

This exercise summarizes the stakeholders for the general waste from the stage of production to disposal or incineration. The stakeholders responsible for logistics, and management, and the type of waste disposed within the campus have been studied. The results indicates that many disposed waste can be recycled if it has been segregated to avoid contaminant.

To achieved the EcoCampus objective and align with the Sustainable Singapore Blueprint towards zero waste, NTU should increase its recycling activities by influencing the waste producer and collaborate further with waste recycling companies.

However, there is a lack of information on the waste producers' knowledge, attitude and practice towards waste and recycling in NTU.

Hence, in order to reduce the waste intensity in the campus and proposed the appropriate campaign for waste recycling, a waste audit and behavioural study should be conducted.

REFERENCE:

- <http://www.mewr.gov.sg/ssb/files/ssb2015.pdf>
- <http://www.sciencedirect.com.ezlibproxy1.ntu.edu.sg/science/article/pii/S0959378008000964>

Paper	Plastic	Electronics	Styrofoam	Organics:
<ul style="list-style-type: none"> • Cardboard • Paper bags • Paper packaging • Paper cups • Newspaper 	<ul style="list-style-type: none"> • Plastic Bottles • Plastic Bags • Plastic Packaging • Plastic Food packaging • Plastic Food container 	<ul style="list-style-type: none"> • Househods battery • Cables 	<ul style="list-style-type: none"> • Food packaging 	<ul style="list-style-type: none"> • Food waste • Leaves

Figure 5: Simplified Waste Disposed Categorization by Observation