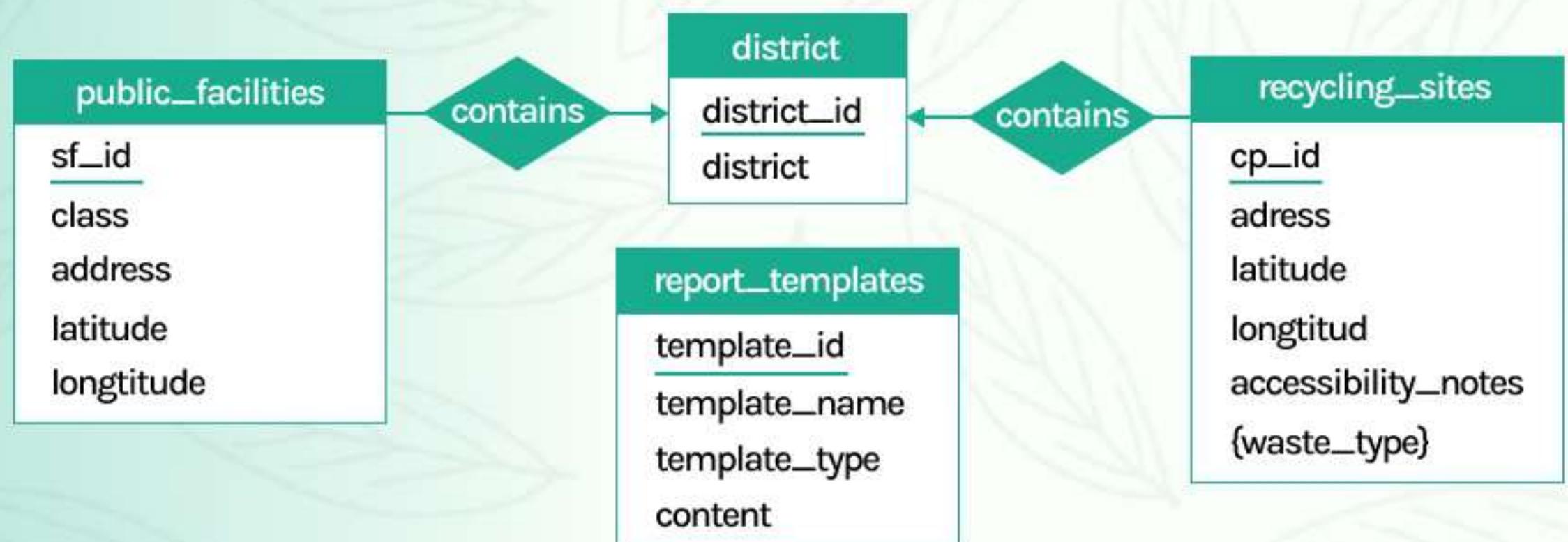


DATA SOURCE

The datasets were acquired from CSV files provided by data.gov.hk

Service Information of Public Places	Hong Kong Waste Recycling Points
GEONAMEID ENGLISHNAME/CHINESENAME CLASS_TYPE / SUBCAT EASTING / NORTHING E_FLOOR / C_FLOOR E_AREA / C_AREA E_DISTRICT / C_DISTRICT E_REGION / C_REGION E_ADDRESS / C_ADDRESS	cp_id cp_state district_id address_en/address_tc/address_sc lat / lgt waste_type legend accessibility_contact_en

ENTITY-RELATIONSHIP



Website Design

Automated Content Management System

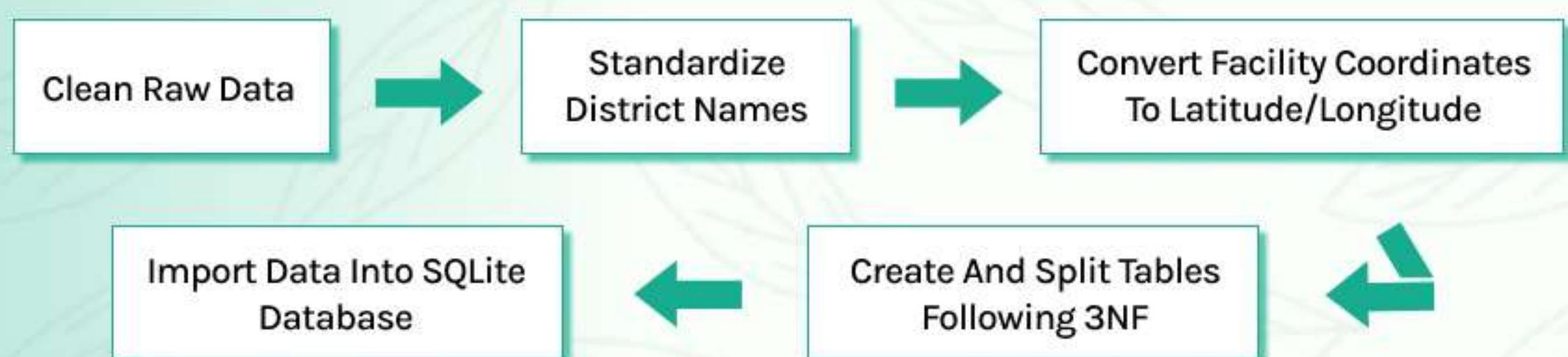
In recent years, Hong Kong has witnessed a continuous increase in both public facilities and recycling stations; however, there exists a marked fragmentation between the two in terms of planning and information.

In this project, we aim to develop a "Smart Green Recycling Navigator", seeking to transform open data into interpretable and actionable views of recycling infrastructure for both citizens and urban planners.

Group Coursework 2025.11

SMART GREEN RECYCLING NAVIGATOR

Process



SOLUTION - HTML

Index

Map

Interactive Recycling Map
Folium multi-layer interactive map with waste type filtering and public facility overlay

[Launch Map](#)

Search

Nearby Facility Search System
Find recycling points by nearby public facilities

[Open System](#)

Search

Waste Category Search System
Find recycling points by waste type

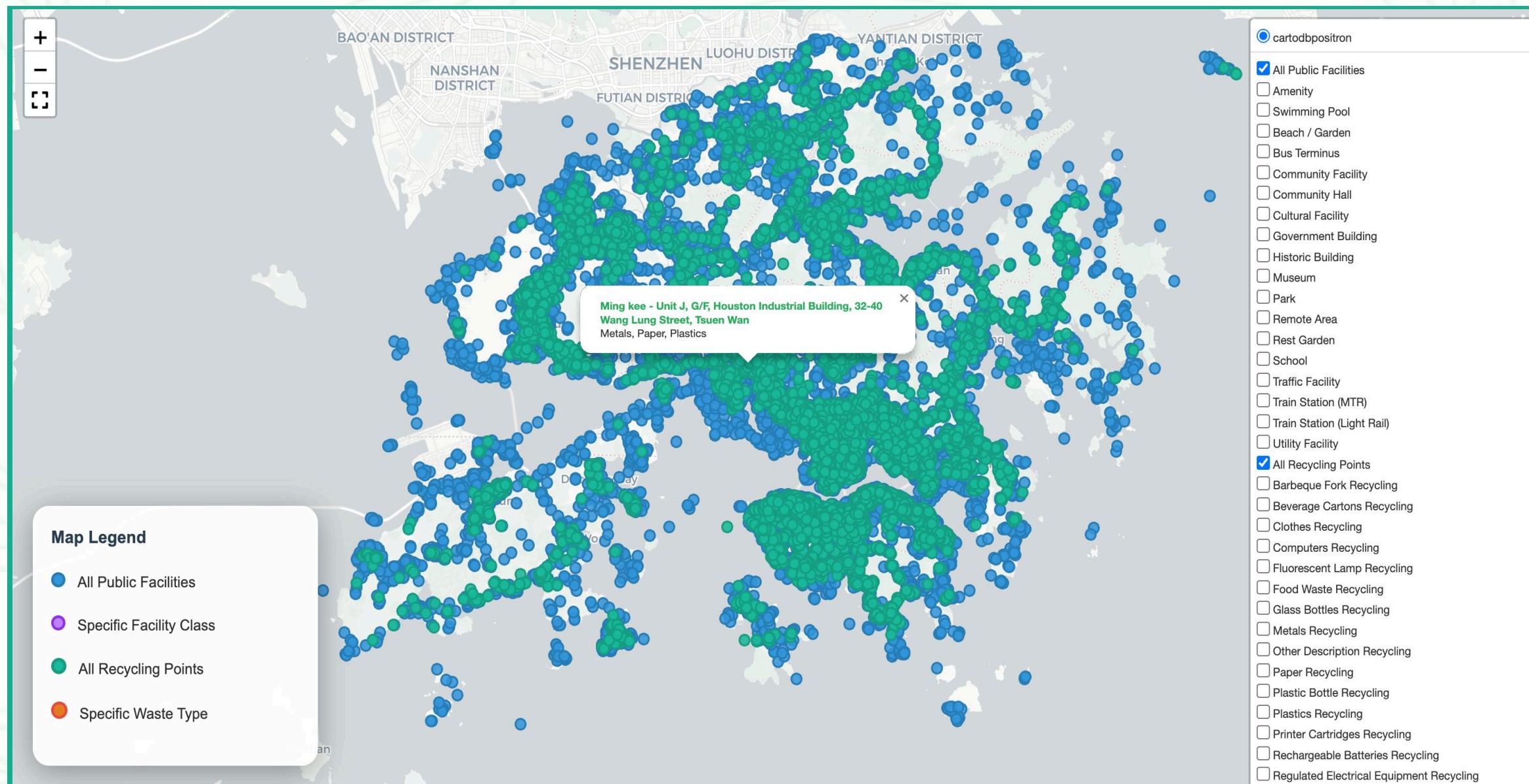
[Open System](#)

Interactive Automated Reports (Select to Generate)

- 01 Waste Type Coverage Analysis
Select any waste type → instantly view network coverage percentage
- 02 District Accessibility Analysis
Select district → view average distance to nearest recycling point
- 03 Facility Class Conveniences Analysis
Select facility type → compare recycling sites within 500m vs 1000m
- 04 District Infrastructure Comparison
Select district → compare recycling points vs public facilities

Interactive Map

Interactive map featuring toggleable filters, density heatmaps, and clickable data points to support data-driven sustainability analysis.



1. Interactive Map

2. Search System

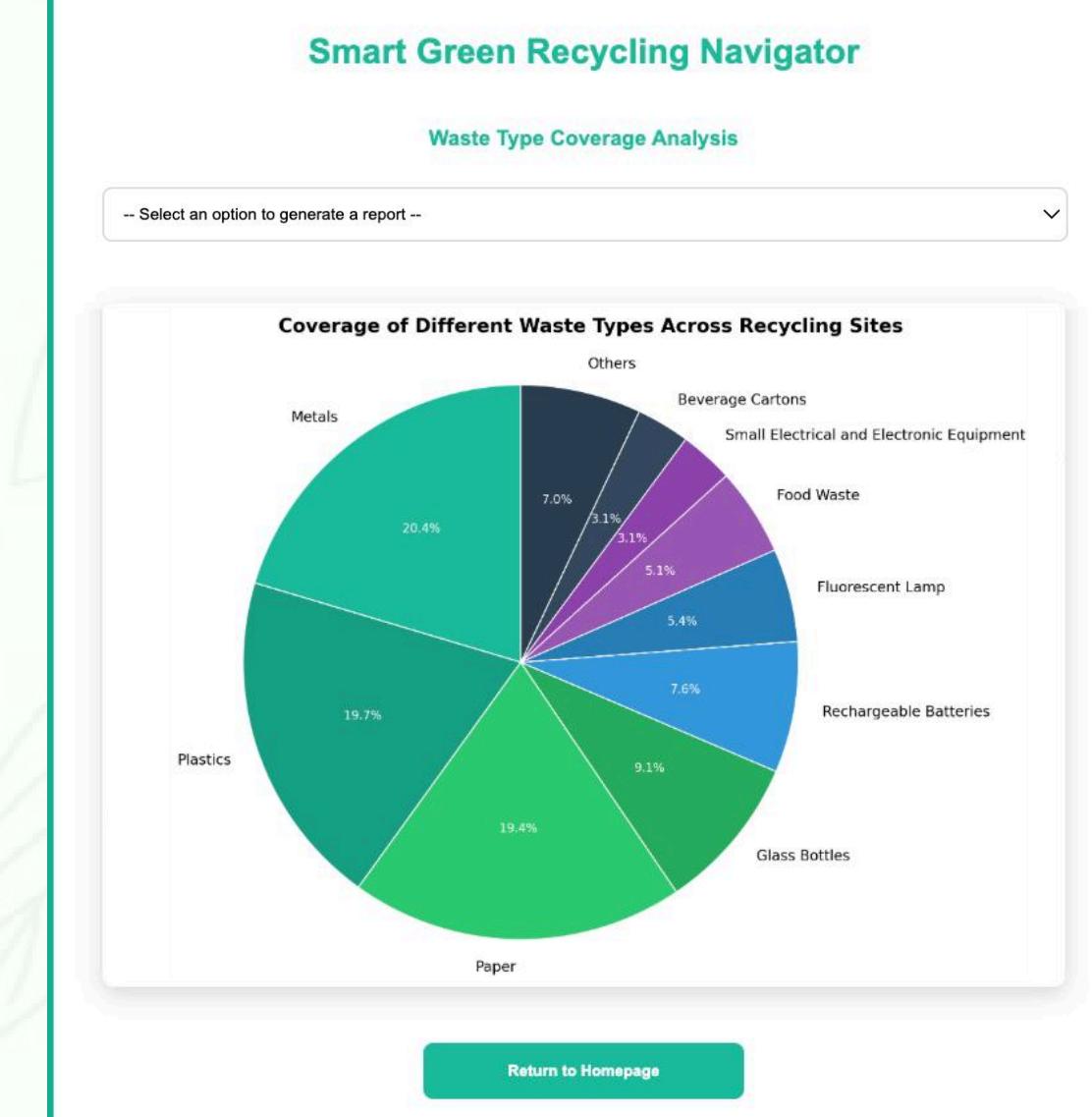
Nearby Facility search System
Waste Category search System

3. Visualized Report

Waste Type Coverage Analysis
District Accessibility Analysis
Facility Class Conveniences Analysis
District Infrastructure Comparison

Visualized Report

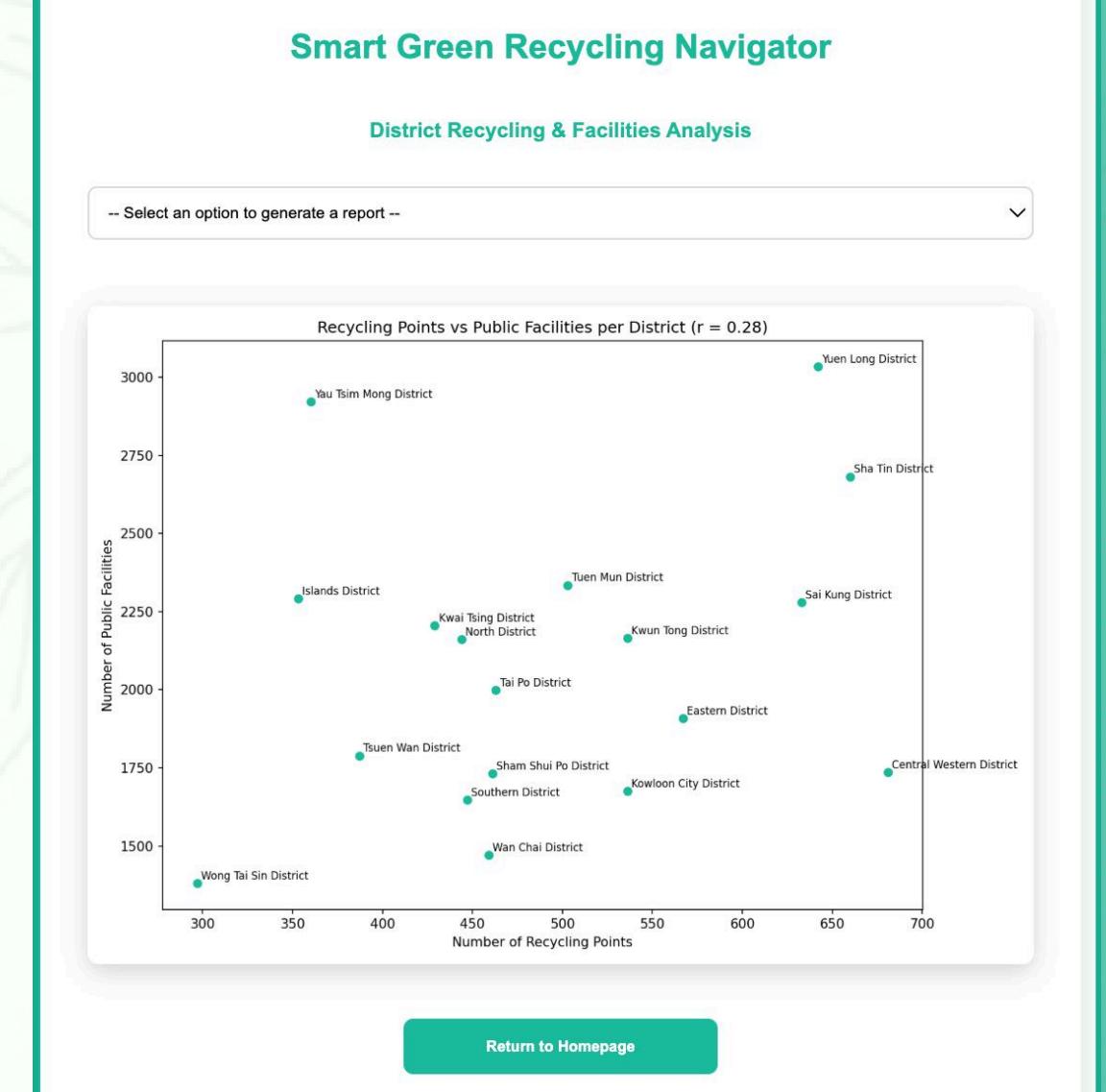
Waste Type Coverage Analysis



District Accessibility Analysis



District Infrastructure Comparison



Facility Class Conveniences Analysis



SOLUTION - HTML

Waste Category Search System

Query by Waste Category

District Option

Waste Type Option

Select Waste Types for Query

8858
8858 Recycling Points • 16 Waste Types • 18 Districts

Paper (selected)

Barbecue Fork Beverage Cartons Clothes Computers Fluorescent Lamp
Food Waste Glass Bottles Metals Other Description Paper
Plastic Bottle Plastics Printer Cartridges Rechargeable Batteries Regulated Electrical Equipment
Small Electrical and Electronic Equipment

Query Recycling Sites

Clear Selection

Query Results

Filter by District
Kowloon City District (selected)

Central Western District Eastern District Islands District Kowloon City District Kwai Tsing District
Kwun Tong District North District Sai Kung District Sha Tin District Shau Shui Po District
Southern District Tai Po District Tsuen Wan District Tuen Mun District Wan Chai District
Wong Tai Sin District Yau Tsim Mong District Yuen Long District

Apply District Filter

Clear District Selection

Show All Results

Matching Information

Number of Recycling Points

Recycling Point Details

411
Recycling points that accept "Paper" in Kowloon City District

Kowloon City District
Address: Public pavement at junction of Kau Pui Lung Coord: (22.31792, 114.18649)
Road and Lok Shan Road outside Morning Joy Building, Kowloon City

Acceptable Waste Types: Beverage Cartons, Fluorescent Lamp, Glass Bottles, Metals, Paper, Plastic Bottle, Plastics, Rechargeable Batteries, Regulated Electrical Equipment, Small Electrical and Electronic Equipment

Accessibility Notes: For public use

Kowloon City District
Address: Public pavement of 220 Ma Tau Wai Road Coord: (22.31376, 114.18745)
outside Chat Ma Mansion, Kowloon City

Acceptable Waste Types: Beverage Cartons, Fluorescent Lamp, Glass Bottles, Metals, Paper, Plastic Bottle, Plastics, Rechargeable Batteries, Regulated Electrical Equipment, Small Electrical and Electronic Equipment

Accessibility Notes: For public use

Kowloon City District
Address: Public pavement of Pak Kung Street outside Pak Tai Temple, Kowloon City Coord: (22.31119, 114.18744)

Acceptable Waste Types: Beverage Cartons, Fluorescent Lamp, Glass Bottles, Metals, Paper, Plastic Bottle, Plastics, Rechargeable Batteries, Regulated Electrical Equipment, Small Electrical and Electronic Equipment

Accessibility Notes: For public use

Kowloon City District
Address: Kai Tak Station Square Phase I Coord: (22.33151, 114.20055)

Acceptable Waste Types: Metals, Paper, Plastics

Accessibility Notes: For public use

Kowloon City District
Address: Wang Kwong Road Sitting-out Area Coord: (22.32989, 114.20521)

Acceptable Waste Types: Metals, Paper, Plastics

Accessibility Notes: For public use

Nearby Facility Search System

Query by Facility

District Option

Facility Type Option

Facility Name Manual Input

Query Facilities and Nearby Recycling Sites

Select District:
Kowloon City District

Search Method:
Search by Facility Name
✓ Search by Facility Type

Facility Type:
Bus Terminus

Search Facilities

Matching Information

Facility Details

Matching Facilities

Facility 1 ID: 21246535
Type: Bus Terminus BUS
Name: Shing Kai Road northbound bus lay-by outside Kai Ching Estate
Address: Shing Kai Road northbound bus lay-by outside Kai Ching Estate
District: Kowloon City District
Coordinates: 22.332059, 114.204684

Find Nearest 5 Recycling Sites

Facility 2 ID: 21116434
Type: Bus Terminus BUS
Name: Kai Tak - Victoria Sky, Muk On Street
Address: Kai Tak - Victoria Sky, Muk On Street
District: Kowloon City District
Coordinates: 22.328826, 114.202084

Find Nearest 5 Recycling Sites

Facility 3 ID: 21243685
Type: Bus Terminus BUS
Name: Kai Tak - MTR Exit A, Muk On Street
Address: Kai Tak - MTR Exit A, Muk On Street
District: Kowloon City District
Coordinates: 22.329648, 114.201122

Find Nearest 5 Recycling Sites

Nearby Recycling Sites

Selected Facility: Kai Tak - MTR Exit A, Muk On Street ID: 21243685
Type: Bus Terminus BUS
Name: Kai Tak - MTR Exit A, Muk On Street
Address: Kai Tak - MTR Exit A, Muk On Street
District: Kowloon City District
Coordinates: 22.329648, 114.201122

Recycling Site #1 0.06 km
Distance from Facility: 0.06 km
Site ID: 12019
Address: Kai Tak Avenue Park (Near basketball court)
District: Kowloon City District
Accessibility: Note: For public use
Coordinates: 22.329902, 114.201639

Recycling Site #2 0.10 km
Distance from Facility: 0.10 km
Site ID: 12493
Address: T-Loft@Kai Tak
District: Kowloon City District
Accessibility: Note: For residents of the estate only
Coordinates: 22.329680, 114.202060

Recycling Site #3 0.10 km
Distance from Facility: 0.10 km
Site ID: 9920
Address: Kai Long Court
District: Kowloon City District
Accessibility: Note: For residents of the estate only
Coordinates: 22.330550, 114.201110

Recycling Site #4 0.10 km
Distance from Facility: 0.10 km
Site ID: 10607
Address: One Kai Tak(i)
District: Kowloon City District
Accessibility: Note: For residents of the estate only
Coordinates: 22.328897, 114.200571

Nearest 5 Recycling Sites Statistics
Total sites displayed: 5
Sites within 1km: 5
Closest site: 0.06 km
Farthest site displayed: 0.11 km
Average distance: 0.09 km

Matching Information

Facility Details

Nearest 5 Recycling Points

Recycling Points Details

CODING

Github: <https://github.com/Kinley1212>

Database Table Structure

```
/*1.Create Districts Table */
CREATE TABLE IF NOT EXISTS districts (
    district_id INTEGER PRIMARY KEY AUTOINCREMENT,
    district TEXT
);

/* 2.Create Recycling Sites Table */
CREATE TABLE IF NOT EXISTS recycling_sites (
    cp_id TEXT PRIMARY KEY,
    district TEXT,
    address TEXT,
    latitude REAL,
    longitude REAL,
    accessibility_notes TEXT,
    FOREIGN KEY (district) REFERENCES districts (district)
);

/* 3.Create Waste Types Table (One-to-Many Relationship) */
CREATE TABLE IF NOT EXISTS site_waste_types (
    id INTEGER PRIMARY KEY AUTOINCREMENT,
    cp_id TEXT,
    waste_type TEXT,
    FOREIGN KEY (cp_id) REFERENCES recycling_sites (cp_id)
);

/* 4.Create Public Facilities Table */
CREATE TABLE IF NOT EXISTS public_facilities (
    sf_id TEXT PRIMARY KEY,
    district TEXT,
    class TEXT,
    address TEXT,
    latitude REAL,
    longitude REAL,
    FOREIGN KEY (district) REFERENCES districts (district)
);

/* 5.Create Report Templates Table (For HTML Generation) */
CREATE TABLE IF NOT EXISTS report_templates (
    template_id INTEGER PRIMARY KEY AUTOINCREMENT,
    template_name TEXT NOT NULL,
    template_type TEXT NOTNULL,
    content TEXT NOT NULL,
    UNIQUE(template_name)
);

/* Insert District Data */
INSERT OR IGNORE INTO districts (district)
VALUES (?);

/* Insert Public Facility Data */
INSERT OR IGNORE INTO public_facilities
(sf_id,district,class,address,latitude,longitude)
VALUES (?,?,?,?,?,?);

/* Insert Recycling Site Data */
INSERT OR IGNORE INTO recycling_sites
(cp_id,district,address,latitude,longitude,accessibility_notes)
VALUES (?,?,?,?,?,?);

/* Insert Waste Type Tags */
INSERT INTO site_waste_types (cp_id,waste_type)
VALUES (?,?);

/* Insert or Update Report Templates */
INSERT OR IGNORE INTO report_templates (template_name,
template_type,content)
VALUES (?,?,?);
```

SQL Queries

```
WITH facility_counts AS (
    SELECT
        sf_id,
        SUM(CASE WHEN within_500 THEN 1 ELSE 0 END) AS count_500,
        SUM(CASE WHEN within_1000 THEN 1 ELSE 0 END) AS count_1000
    FROM pairs_buffer
    GROUP BY sf_id
)
SELECT
    CASE fclass
        WHEN 'PAK' THEN 'Park'
        WHEN 'SCH' THEN 'School'
        WHEN 'TRH' THEN 'Train Station (MTR)'
        WHEN 'BUS' THEN 'Bus Terminus'
        WHEN 'GOV' THEN 'Government Building'
        ELSE fclass || '(Other)'
    END AS facility_type,
    ROUND(AVG(fc.count_500),2) AS avg_sites_500m,
    ROUND(AVG(CASE WHEN fc.count_500 > 0 THEN 100.0 ELSE 0.0 END),1) || '%' AS coverage_500m,
    COUNT(*) AS total_facilities
FROM facility_counts fc
JOIN public_facilities f ON fc.sf_id = f.sf_id
GROUP BY fclass
ORDER BY avg_sites_500m DESC;

SELECT
    rs.cp_id,
    rs.district,
    rs.address,
    rs.latitude,
    rs.longitude,
    rs.accessibility_notes,
    GROUP_CONCAT(swt.waste_type) as waste_types
FROM recycling_sites rs
LEFT JOIN site_waste_types swt ON rs.cp_id = swt.cp_id
WHERE rs.latitude IS NOT NULL AND rs.longitude IS NOT NULL
GROUP BY rs.cp_id;

/* Get distinct list of districts */
SELECT DISTINCT district FROM districts ORDER BY district;

/* Get distinct list of waste types */
SELECT DISTINCT waste_type FROM site_waste_types ORDER BY waste_type;

/* Count total public facilities per district */
SELECT
    district,
    COUNT(*) AS facilities
FROM public_facilities
GROUP BY district
ORDER BY district;

SELECT
    f.district,
    AVG(tmin_dist_m) AS avg_min_dist
FROM (
    SELECT
        sf_id,
        MIN(dist_m) AS min_dist_m
    FROM pairs_dist
    GROUP BY sf_id
)
JOIN public_facilities AS f
    ON tsf_id = fsf_id
GROUP BY f.district
ORDER BY avg_min_dist DESC;

SELECT
    swwaste_type,
    COUNT(*) AS site_count
FROM site_waste_types AS sw
JOIN recycling_sites AS rs
    ON sw.cp_id = rs.cp_id
WHERE sw.waste_type IS NOT NULL
GROUP BY sw.waste_type
ORDER BY site_count DESC;
```

Folium Map (Partial)

```
# 1.Data Retrieval
conn = sqlite3.connect(DB_PATH)
recycling_df = pd.read_sql_query("""
    SELECT rs.*, GROUP_CONCAT(swt.waste_type) AS types_str
    FROM recycling_sites rs
    LEFT JOIN site_waste_types swt ON rs.cp_id = swt.cp_id
    GROUP BY rs.cp_id
""", conn)
conn.close()

# 2.Map Initialization
m = folium.Map(location=[22.3193, 114.1694], zoom_start=11.6, tiles="CartoDB positron")
title_html = """
<h3 align="center" style="font-size:26px;font-weight:bold;margin:0;color:white;background:#1BAC8F;padding:18px 0;">
    Hong Kong Smart Recycling Navigator
</h3>
"""
m.get_root().html.add_child(folium.Element(title_html))

# 3.Layer Generation
# Example 1: Layer for Recycling Points
fg_all_rec = folium.FeatureGroup(name="All Recycling Points", show=True)
for _, row in recycling_df.iterrows():
    types = ",".join(row.waste_types) if row.waste_types else "General"
    folium.CircleMarker(
        location=[row.latitude, row.longitude],
        radius=4.5,
        color=RECYCLE_BORDER,
        fillColor=RECYCLE_COLOR,
        fillOpacity=0.92,
        popup=folium.Popup(f"<b style='color:#27ae60>Recycling Point</b><br>{types}<br>{max_width=300},<br>tooltip=<strong>Recycling Point</strong>" ),
        add_to( fg_all_rec )
    ).add_to( fg_all_rec )
fg_all_rec.add_to(m)

# Example 2: Layer for Public Facilities
fg_all_fac = folium.FeatureGroup(name="All Public Facilities", show=True)
for _, row in facilities_df.iterrows():
    # Handle potentially missing or unknown facility classes
    code = row['class'] if pd.notna(row['class']) else "Unknown"
    full_name = class_full_name.get(code, code) # Map code to readable name
    folium.CircleMarker(
        location=[row.latitude, row.longitude],
        radius=4.5,
        color=PUBLIC_COLOR,
        fillColor=PUBLIC_FILL,
        fillOpacity=0.88,
        popup=folium.Popup(f"<b style='color:#2980b9>{full_name}</b><br>{row.address}<br>{max_width=300},<br>tooltip=<strong>{full_name}</strong>" ),
        add_to( fg_all_fac )
    ).add_to( fg_all_fac )
fg_all_fac.add_to(m)

# 4.Advanced Visualization: Density Heatmap
plugins.HeatMap(recycling_df[["latitude","longitude"]].values.tolist(),
    name="Recycling Density Heatmap", radius=16, blur=22, show=False).add_to(m)

# 5.UI Integration: Custom HTML Legend & Controls
legend_html = """
<div style="position:fixed; bottom:20px; left:20px; width:280px; background:rgba(255,255,255,0.98); ">
    <b style="font-size:16px; color:#2c3e50;">Map Legend</b><br>
    </div>
"""
m.get_root().html.add_child(folium.Element(legend_html))
folium.LayerControl(collapsed=False).add_to(m)
plugins.Fullscreen().add_to(m)
m.save(map_path)
```

Visualized Reports (Partial)

```
# 1.Data Retrieval: SQL Query with JOIN & Aggregation
sql_waste = """
SELECT sw.waste_type, COUNT(*) AS site_count
FROM site_waste_types AS sw
JOIN recycling_sites AS rs ON sw.cp_id = rs.cp_id
WHERE sw.waste_type IS NOT NULL
GROUP BY sw.waste_type
ORDER BY site_count DESC;
"""
df_waste = pd.read_sql_query(sql_waste, conn)

# 2.Data Processing: Group small categories into 'Others'
waste_pct = df_waste.set_index(waste_type)[site_count]/df_waste[site_count].sum() * 100
small = waste_pct[waste_pct < 3.0]
if not small.empty:
    waste_pct = waste_pct[waste_pct >= 3.0]
    waste_pct['Others'] = small.sum()

# 3.Visualization: Pie Chart
pltPie(
    waste_pct,
    labels=waste_pct.index,
    autopct=lambda pct:f'{pct:.1f}%' if pct >= 3 else '',
    colors=colors[:len(waste_pct)],
    wedgeprops={edgecolor:'white', linewidth:1} # Aesthetic separation
)
plttitle("Coverage of Different Waste Types")
pltshow()

# 1.Advanced Spatial SQL: Buffer Analysis & Classification
sql_class_stats = """
WITH facility_counts AS (
    SELECT
        sf_id,
        SUM(CASE WHEN within_500 THEN 1 ELSE 0 END) AS count_500,
        SUM(CASE WHEN within_1000 THEN 1 ELSE 0 END) AS count_1000
    FROM pairs_buffer
    GROUP BY sf_id
)
SELECT
    CASE fclass
        WHEN 'PAK' THEN 'Park'
        WHEN 'SCH' THEN 'School'
        ELSE fclass # mapping other codes
    END AS facility_type,
    ROUND(AVG(fc.count_500),2) AS avg_sites_500m,
    ROUND(AVG(fc.count_1000),2) AS avg_sites_1000m
FROM facility_counts fc
JOIN public_facilities f ON fc.sf_id = f.sf_id
GROUP BY f.class
ORDER BY avg_sites_500m DESC;
"""

class_stats = pd.read_sql_query(sql_class_stats, conn)

# 2.Comparative Visualization
top_classes = class_stats.head(10)
x = np.arange(len(top_classes))
width = 0.35
pltfigure(figsize=(10,6))
pltbar(x - width/2, top_classes['avg_sites_500m'], width, label='Within 500m', color="#1abc9c")
pltbar(x + width/2, top_classes['avg_sites_1000m'], width, label='Within 1000m', color="#e67e22")
plttitle("Recycling Accessibility by Facility Type")
pltLegend()
plttight_layout()
pltshow()
```