Good Practice Guide to Water Conservation for Hotels in Hong Kong
Forward...

Hotels and the environment...

According to World Travel & Tourism Council (WTTC) in 1998 revenues for Hong Kong’s travel and tourism industry was HK$72.6 billion, brought in by 9.6 million visitors, of which 32% were business travellers. Despite the reduction from the recent economic downturn such numbers are large in comparison with Hong Kong’s permanent population of around 6.3 million, and have a significant impact on its environmental loading.

Hong Kong is no exception to the growing world-wide recognition and acceptance of the moral, ethical, social and political arguments for taking action on environmental issues. For the Hong Kong hotel sector, there are sound business reasons for operators to pay attention to good environmental practices. This includes increased profitability and the potential for improved market share.

This Guide...

This Guide is based on a number of water conservation projects carried out in hotel buildings in Hong Kong over recent years. If applied, the experience and knowledge gained can be effective in reducing water consumption in hotel buildings. It is intended that this guide will help to reduce water consumption in hotels in Hong Kong, contributing to their profitability whilst helping to reduce environmental impacts.

In preparing this guide, references have been made to a number of publications relating to water conservation programmes in commercial buildings including hotels, by both government and professional organisations. A list of further reading materials is included at the end.

The original version of this guide was prepared by staff from the Department of Building Services Engineering, The Hong Kong Polytechnic University. It was published in 1996 following an initiative by Mr. Jean-Marie Leclercq, General Manager Hotel Nikko Hong Kong, with the aid of funding from the Shell Better Environmental Award Scheme. The original energy and water conservation guide has been split into two separate guides and updated as part of the deliverables from the project ‘Keeping Hong Kong’s Hotel Industry Competitive into the 21st Century: Environmental Management for Hotels’ This project was funded through the Service Supported Fund administered by the Industry Department, The Government of the Hong Kong Special Administration Region.

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**Introduction...**

A large hotel is a unique combination of occupancies and facilities and apart from guest rooms, may include restaurants, kitchens, function rooms, car parks, bars and coffee shops, retail shops. Many have on-site laundry facilities, sometimes with dry cleaning services. Swimming pools and health clubs are also found in the larger hotels.

**Water use in hotels...**

Large amounts of water is used in a hotel building by its laundry, kitchen and guest rooms, with significant energy use for producing hot water. In a typical medium size hotel in Hong Kong, the annual bills for water and sewage discharge may amount up to one million dollars, contributing significantly to hotel’s total operating cost.

Over the last few years, extensive work on water audit and survey was carried out in many hotels in Hong Kong, and implementing appropriate water conservation measures has resulted in significant water savings. A reduction in hotel's operating cost from direct water saving and indirect energy saving from saving hot water use has made a noticeable difference to the 'bottom line'.

**Water conservation projects...**

This guide is prepared specifically for the use by the hotels in Hong Kong based on the experiences obtained through these water audit and survey projects carried out in hotel buildings in Hong Kong.

**Contents...**

There are totally four main parts in this guide. In part 1, a detailed checklist is firstly presented. It is intended that this checklist can be separated from the main body of the guide to become a handy reference for staff in a hotel. A brief description of water services installation in typical Hong Kong hotel buildings is presented in part 2. This is followed by reporting averaged water use benchmarking data, water use characteristics and water consumption pattern in local hotels, based on a recent water audit in approximately one fifth of quality hotels in Hong Kong in part 3. In the last part, actions that can be taken by the engineering staff in a hotel are detailed. The focus in this section is on analysing system performance and identifying saving potential through undertaking detailed water surveys and measurement. Where appropriate, illustrative data from and methodologies adopted in hotel audit projects will be included to demonstrate "what to do" and "what can be done" for improving water use performance in hotel buildings in Hong Kong.
Part I

Good Housekeeping Practices Checklist...

The following “Good Housekeeping Practices Checklist” is intended for all staff working in a hotel to guide them in their routine work in good housekeeping practices which minimise wastage of water. It is by no means exhaustive and hotel management, and section or department heads, might design their own list, appropriate to the work nature in their respective sections.

Kitchens...

- Turn on water tap only when needed and never let water running continuously;
- Adjust water flow rate and water temperature to suit different kitchen and cleaning;
- Hand scrape as much soil from dishware as possible and pre-soak dirty dishware properly before washing in dishwasher to reduce the possibility of re-washing; Reuse pre-soaking water if possible;
- Operate dishwashers at or near their full load to minimise the number of operation;
- Arrange chemical supplier to check regularly whether washing results of dishwashers meet the sanitation requirements;
- Check and clean all dishwashers regularly and ensure temperature settings of dishwashers are maintained at recommended levels;
- Use running water for washing and cleaning is not recommended;
- Reuse unused ice collected from buffet tables to wash kitchen floor;
- Keep kitchens clean at all times to reduce the amount of water used before closing at the end of a day;
- Clean daily and check frequently all kitchen equipment for highest possible efficiency;
- Follow the operating instructions of kitchen equipment manufacturers;
- Check whether all water taps are fully closed before going off duty;
- Report any leaking tap to Engineering Department immediately for repairing;
- Post stickers and posters on staff notice boards and working areas to draw attention on the significance of water saving.
Laundry...

- Run full loads in washing machines to minimise number of operations. Weigh loads if necessary;
- Ensure that water temperature and amount of water are in accordance with the specification by washing machine manufacturer;
- Use different washing programmes as suggested by laundry chemical supplier and washing machine manufacturer for washing different grading of soiled linen to reduce the possibility of re-washing;
- Arrange laundry chemical supplier to test the performance of cleaning chemicals regularly to ensure that the most suitable cleaning chemicals are selected and the most economic / efficient washing cycles are determined;
- Check regularly all laundry equipment for highest possible efficiency;
- Make sure that all water taps are closed after use;
- Report any leaking taps to the Engineering Department immediately for repair;
- Post stickers and posters on staff notice boards and working areas to draw attention on the significance of water saving.

Guestrooms...

- Encourage guests to re-use bedding linen and towels by placing tent cards in guestrooms to reduce laundry load;
- Report any leaking taps, running toilets and similar faults to Engineering Department immediately for repairing;
- Do not leave tap water running during room cleaning;
- Make sure that all water taps are closed after use.
Significant Savings …

The following diagrams show the water consumption pattern and the accumulated total water saving over a period of 6 years in a local hotel. The hotel implemented a water conservation programme in 1994, since then there have been significant water use reductions, which was particular significant in the first few years. These clearly demonstrate the financial benefit a hotel can achieve, let alone to gain a reputation of being active in protecting the environment.

Water consumption…

Between 1994 and 1999, while the average occupancy remained steady between 80 and 90%, water use reduced by about 19%.

Accumulated saving… This graph shows the accumulated water saving, compared to the reference year of 1994.
Every hotel Hong Kong provides deluxe services including guestrooms, restaurants and bars, recreational, hygiene and health care, and other supporting facilities to the guests. A considerable amount of water is therefore required in a hotel for its daily operation. In each hotel, water is transported to, and discharged from, different facilities via the following water services systems:

**Cold and hot water...**

Cold water supply is usually supplied by a gravity system. Potable water from the main feed pipe is transferred to tanks at roof or mechanical floor levels by up-feed pumps and then serves the outlets at lower levels by gravity. For outlets near the rooftop, booster pumps may be used for pressurisation (Figure 1).

![Figure 1 Cold and hot water](image)

Hot water supply to the guestrooms and kitchens is normally by using a central water heating system. Water is heated by the steam in a steam-heated calorifier. Circulation pumps are installed for hot water supply to each outlet.
**Flushing water...**

The flushing water supply is similar to potable water supply, except that the two systems are totally separated because the medium for flushing in urban district in Hong Kong is seawater.

**Swimming pool...**

Many hotels in Hong Kong are equipped with a swimming pool. Some may have more than one pool (i.e. indoors and outdoors). A swimming pool requires a water treatment plant to maintain the water quality (Figure 2).

![Figure 2 Schematic of swimming pool piping network](image)
Drainage system... A drainage system (Figure 3) is provided for all toilets, bathrooms, laundry, kitchen sinks and car parks. Drainage pipe work from kitchens and car-parks are connected with grease and oil traps before discharging into main stacks. Rainwater from roof level and podium level is collected using separated stacks.

Figure 3 Drainage system schematics

Measuring water consumption... Normally there is only one fresh water flow meter which measures the total amount of fresh water consumption in a hotel building. The meter is located in the main water supply pipe to a hotel building from city main. If a breakdown of water use by various end-uses in a hotel such as kitchen, laundry or guest floors, water sub-meters are then required to be installed in these end-use areas.
Part III
Water Use in Hotels in Hong Kong...

An intensive audit of water consumption in about 20% of leading hotels in Hong Kong was carried out, based on consumption data for the year 1995. Water use performance in each hotel was assessed by using Water Use Index (WUI). A WUI was defined as the annual total site water consumption per unit of gross floor area of the hotel building (m³/m²). An averaged WUI was obtained, and may be used as benchmarking data for assessing water use performance in other hotels.

Water use index (WUI)...

The WUI for each hotel using 1995 consumption data was calculated. The WUIs vary significantly from one hotel to another, as shown in Table 1. The average is 4.5 m³/m².

<table>
<thead>
<tr>
<th>WUI (m³/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
</tr>
<tr>
<td>Min</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>SD</td>
</tr>
</tbody>
</table>

Breakdown of water use in hotel buildings...

Major water end-users in a hotel building are identified as laundry (if any), guest floors and kitchens. Figure 4 and 5 show the percentage breakdown of water consumption in two types of hotel (one with laundry and the other without). It can be seen from the diagrams that in a hotel with laundry, water consumption in the laundry may dominate the total consumption, while that for guest floor and kitchen may dominate the total in a hotel without an in-situ laundry.
Figure 5  Breakdown of water consumption (with laundry)

Water consumption characteristics...
Figure 6 is a typical hourly water consumption pattern in guest floors. There were two peaks of water consumption. The first was from 7:00 a.m. to 10:00 a.m., with a maximum occurring at around 8:00 a.m., the morning washing period for hotel guests. The second was from 8:00 p.m. to 11:00 p.m., with a maximum of 11.6 m³/h occurring at around 10:00 p.m..

Figure 6  An example of hourly water use profile in a local hotel

Figure 7 shows that the total monthly laundry washing load, the monthly total number of guests and the monthly total number of food covers would jointly influence the total monthly water consumption in a hotel building.
In Figure 8, the relationship between monthly mean outdoor air temperature and monthly total water use in a hotel is presented. It indicates that the water use in the hotel is generally not affected by the variation of outdoor air temperature.

**Cost implications...** Hotels that consume less water (with low WUI) not only conserve natural resources and reduce the adverse environmental impacts of discharging wastewater, but also save operation costs. For hotels in Hong Kong, apart from paying to the Government water charges at a rate of $4.58/m³, hotel owners have to pay to the Government both sewage charges and trade effluent surcharges under...
the Sewage Services Ordinance which is enforced by the Drainage Service Department (DSD).

Calculating sewage charge...

For the calculation of sewage charges for hotels, a weighted average discharge factor is multiplied to the volume of water supplied accounting for water consumption and any other losses, and then multiplied by $1.20/m^3. This factor will vary slightly according to the differences in the percentage of water consumption in the hotel sections (guestroom services, laundries, restaurants and canteen, bakery and barbershop).

Calculating trade effluent surcharge...

For the calculation of trade effluent surcharges for hotels, a weighted average discharge factor is multiplied to the volume of water supplied accounting for water consumption and any other losses, and then multiplied by the applicable rate stated in Schedule 4 Part I of the Sewage Services (Trade Effluent Surcharge) Regulation. This factor will also vary slightly according to the differences in the percentage of water consumption in the hotel sections (guestroom services, laundries, restaurants & canteen, bakery and barbershop).

An example calculation of overall water cost for a typical hotel in Hong Kong is included here for illustration.
Sample calculation of overall water cost for a typical hotel in Hong Kong...

Assuming there is only a single water meter in a hotel for mixed business uses. After detailed consideration of all information of the hotel by the DSD, the following water consumption proportions are estimated and agreed by the hotel:

<table>
<thead>
<tr>
<th>Business Classification Code (HSIC)</th>
<th>Description</th>
<th>Percentage of Water Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>651100</td>
<td>Guestroom services</td>
<td>45.0%</td>
</tr>
<tr>
<td>952000</td>
<td>Laundries</td>
<td>25.0%</td>
</tr>
<tr>
<td>641X00</td>
<td>Restaurants &amp; Canteen</td>
<td>28.5%</td>
</tr>
<tr>
<td>311700</td>
<td>Bakery</td>
<td>1.0%</td>
</tr>
<tr>
<td>959198</td>
<td>Barber shop</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

The weighted average discharge factor and trade effluent surcharge rate of the hotel are then calculated and shown as follows:

<table>
<thead>
<tr>
<th>HSIC</th>
<th>CODt</th>
<th>CODs</th>
<th>Discharge factor (%)</th>
<th>% of Water Consumption</th>
<th>Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CODt</td>
<td>CODs</td>
<td>CODt-s</td>
<td>Discharge factor (%)</td>
<td></td>
</tr>
<tr>
<td>651100</td>
<td>500</td>
<td>350</td>
<td>100</td>
<td>45%</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>157.5</td>
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<td>67.5</td>
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<td>45</td>
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<tr>
<td>952000</td>
<td>725</td>
<td>425</td>
<td>100</td>
<td>25%</td>
<td>181.25</td>
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<td>106.25</td>
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<td>75</td>
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<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>641X00</td>
<td>2000</td>
<td>2000</td>
<td>70</td>
<td>28.5%</td>
<td>570</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>570</td>
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<td>19.95</td>
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<td>2000</td>
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<td>100</td>
<td>1%</td>
<td>20</td>
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<td></td>
<td>15.48</td>
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<td>4.52</td>
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<td></td>
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<td>1</td>
</tr>
<tr>
<td>959198</td>
<td>500</td>
<td>350</td>
<td>100</td>
<td>0.5%</td>
<td>2.5</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1.75</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Weighted average:</td>
<td>998.75</td>
<td>850.98</td>
<td>147.77</td>
<td>91.45</td>
<td></td>
</tr>
</tbody>
</table>

The CODt and CODs for each HSIC refer to Schedule 2 of the Sewage Services (Trade Effluent Surcharge) Regulation. For trade, business or manufacture not listed in the Schedule (e.g. Guestroom services and Barber shop), the CODt and CODs are equal to 500 g/m³ and 350g/m³ respectively. The discharge factor for Restaurant & Canteen is 70% but not 85% for the trade effluent surcharge rate determination as Restaurant & Canteen has to pay both sewage charge and trade effluent surcharge so the discharge factor applied to sewage charge (i.e. 70%) is used.

The weighted average CODs and CODt-s for the hotel are 850.98 g/m³ and 147.77 g/m³ respectively. As all areas of Hong Kong are now declared as Water Control Zone, from Schedule 4 Part I of the Sewage Services (Trade Effluent Surcharge) Regulation, the trade effluent surcharge rate of the hotel is equal to $1.01/m³.

Overall water cost equation

The total cost for usage of water in a typical hotel in Hong Kong per month is therefore represented by the following formula:

\[
C = (4.58/m³ \times V) + (0.91 \times 1.20/m³ \times V) + (0.91 \times 1.01/m³ \times V) = 6.59/m³ \times V
\]

where

\[
C = \text{sum of water charge, sewage charge and trade effluent surcharge per month (S)}
\]

\[
V = \text{volume of total water supply to the hotel per month (m³)}
\]
Part IV  
Actions by Engineering Staff...

Quality maintained... The engineering department is responsible for operating and maintaining all building services systems in a hotel. It should be emphasised here that any measures taken to cut water consumption should not compromise the quality of services and comfort provided. A resources efficient hotel is one in which quality services are maintained but wastage is minimised.

Reduce consumption... The engineering staff should understand that conservation is part of their responsibility. Maintaining the required services and comfort is a priority, but measures to minimise water consumption should be investigated.

Conservation... Consumption is reduced in two ways. Conservation is to reduce unnecessary provision, e.g., by switching off when not needed, or reducing oversupply when not demanded.

Efficiency... Efficiency is about maintaining the required output whilst reducing the input.

Major water users... Major water users in a hotel include kitchens, laundry and guest floors. Water consumption in guest floors is difficult to predict, but to some extent related to hotel occupancy. Even under similar occupancy, water consumption in guest floors might not be similar as it might be related to many different factors such as guest’s personal preference, race, etc. However it is extremely important that care must be taken in implementing water saving measures in guest floors in order not to cause any inconvenience to guests. On the other hand, water conservation practices for laundry and kitchens can be internally carried out without risk of complaints from guests.

Audits... Water audits are systematic studies to establish the quantity and cost of water use in a hotel building over a given period. This is normally a year, either a financial or calendar year.
**Aims...**

Auditing results should aim to provide management with information to assist in decision making, that is:

- establish where water is being used in a hotel, and at what cost;
- help to determine the priorities for more detailed investigation of water use;
- justify investment in measures for improving water use performances; and
- raise the awareness of all staff by providing facts on water use.

**Two stage approach...**

A water audit can be separated into several stages. It is sufficient to audit in two stages:

- preliminary audit - including walk through, survey of systems and equipment;
- full audit - including detailed appraisal of plant and equipment, metering and control.

**Step 1...**

**Preliminary audit...**

The work in a preliminary audit does not require specialist knowledge and deals primarily with water bills and any sub-meter readings. Therefore a preliminary audit on water use based on such available information is highly recommended to establish fundamental information on water use in a hotel.

**Steps...**

There are four steps in a preliminary audit: data collection; data analysis; data presentation and establishing priorities.

**Data...**

Invoice data (monthly bills) are the principal source of date, supplemented where possible by site records.

**Analysis...**

After collecting the data, the followings analysis is performed:

- correlate the figures for each month;
- calculate the total water consumption in an auditing year, and then calculate water use index based on the total floor area.
- where data for previous years are available, a comparison with the audit year should be made to see the overall trend on a yearly basis.
- plot monthly water consumption profile, to clearly shows the seasonal variations relating to weather conditions and to guest room occupancy rates. (e.g. Figure 8)
Consumption patterns...

It is not always true that water consumption is in direct proportion to the monthly average guest room occupancy.

Breakdown by end-uses...

It is highly desirable to break down the total water use in a hotel by end-uses. In general, major water users are laundry (if any), kitchen and guestfloor. (see Figure 4 and 5)

Step 2...
Full audit...

After the preliminary audit on water use for a hotel, detailed on-site investigations and measurements can follow and should focus on major consumption areas identified in Step 1, but other areas should not be ignored. For a full audit external technical assistance may be required as detailed site survey, measurements and analysis are required.

Implementation...

Work in steps 1 and 2 should provide sufficient information for engineering staff to identify potential areas for water conservation. An appropriate water conservation programme can be developed and implemented, in consultation with other departments responsible for the areas where savings are targeted.

List of actions...

The following are a list for actions that can be taken by engineering staff in a hotel to reduce water consumption in a hotel.

- Check and clean plumbing and drainage system components regularly and repair leaking pipes / equipment as soon as possible;
- Reuse waste condensate from laundry and kitchen equipment for producing hot water in calorifiers;
- Reuse swimming pool discharge for the other purposes, such as floor cleaning;
- Use a pool cover to cover the swimming pool to reduce evaporation in summer and heat loss in winter, when the outdoor swimming pool is closed;
- Install a chemical fish pool in kitchen to reduce the frequency of changing water;
- Install a water filter unit on each laundry washing machine to filter out impurities from the water supply to optimise the performance of the machine; Check and replace the filter regularly;
- Recycle rinse water from laundry washing machine for next pre-wash if space for building an additional recycling water tank is available;
- Install a water control system and automatic shut off systems (e.g. automatic water tap) to reduce water use;

- Record daily water consumption data from water meter(s) to monitor water use;

- Install water flow meters with sufficient accuracy at different hotel sections such as kitchens and laundry to facilitate more detailed water consumption monitoring whenever budgets permit and space is available;

- Conduct water audit annually to indicate the current water use profiles.
Benefits of a water control system...

A calibrated water control system was installed in a five-star hotel in May 1995. The system uses a compact valve which is inserted into the hydraulic system and controls the pressure in a water system and regulates the flow in every shower or tap outlet.

The water saving results have been encouraging since the installation. Figure 9 and Figure 10 show the comparison of total water consumption and monthly averaged occupancy in the hotel before and after the installation for a period of 7 months. It is seen from the diagrams that although the occupancy in second half of 1995 was higher than the same period in 1994, the actual water consumption was lower in 1995 than in 1994. On average, the percentage reduction in the total water consumption per guest was 15.5%, and about 20% if the laundry is included.

Figure 9. Total monthly water consumption in a hotel before and after the installation of a water control system for a period of 7 months.
Figure 10. Monthly averaged occupancy in a hotel before and after the installation of a water control system for a period of 7 months.
References...

- "Guide to Environmental Legislation for Hotel Operators in Hong Kong" by John Burnett and Ben Ho, Department of Building Services Engineering, The Hong Kong Polytechnic University, December 1999.

- "A Guide to Energy & Water Conservation in Hotels" by John Burnett and Simon Deng, Department of Building Services Engineering, The Hong Kong Polytechnic University, August 1996.


Useful Web sites...

Environmental Protection Department, The Government of Hong Kong Special Administrative Region.
http://www.info.gov.hk/epd/

Water Supplies Department, The Government of Hong Kong Special Administrative Region.
http://www.info.gov.hk/wsd/

Drainage Services Department, The Government of Hong Kong Special Administrative Region
http://www.info.gov.hk/dsd/

Hong Kong Hotels Association (HKHA)
http://www.hkta.org/hkha/

A Guide to Energy and Water Efficiency for Your Business, Los Angeles Department of Water and Power
http://www.ladwp.com/bizserv/buscon/lighting.htm

Center of Excellence for Sustainable Development – Water Efficiency
http://www.sustainable.doe.gov/efficiency/weinfo.htm

Environmental Division, Hong Kong Institution of Engineers (HKIE)
Http://is7.pacific.net.hk/~hkie_env/

European Environment Agency
http://www.eea.eu.int/

United States Environmental Protection Agency, The United States of America.
http://www.epa.gov/

國家環境保護局, People Republic of China
http://www.sepa-pek.unep.net/