MEBS6000 Utility Services
Session 2: Hot Water Supply
<u>Worked Example on Hot Water Demand Analysis</u>

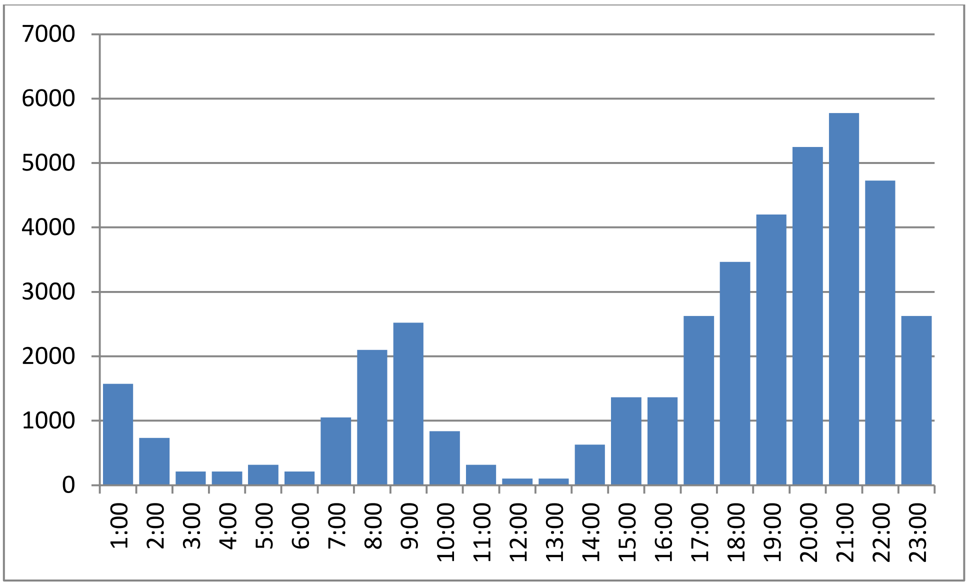
This example explains how hot water demand analysis can assist engineers to identify the capability of a hot water storage plant in catering for existing demand.

Problem:
An increasing demand together with a degrading of the central hot water system has generated complaints from occupants of a serviced apartment that the hot water supply is either 'too cold' or flow of hot water is 'too slow'. In order to study the actual situation, the hot water demand profile is taken for 24 hours as follows:

Hour	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00
Consumption (L)	2100	1575	735	210	210	315	210	1050

Hour	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00
Consumption (L)	2100	2520	840	315	105	105	630	1365

Hour	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
Consumption (L)	1365	2625	3465	4200	5250	5775	4725	2625



Technical Information:
- Existing hot water tank = 10000L
- Existing hot water heater = 150kW
- Design cold and hot water temperature = 10°C & 65°C

Solution:

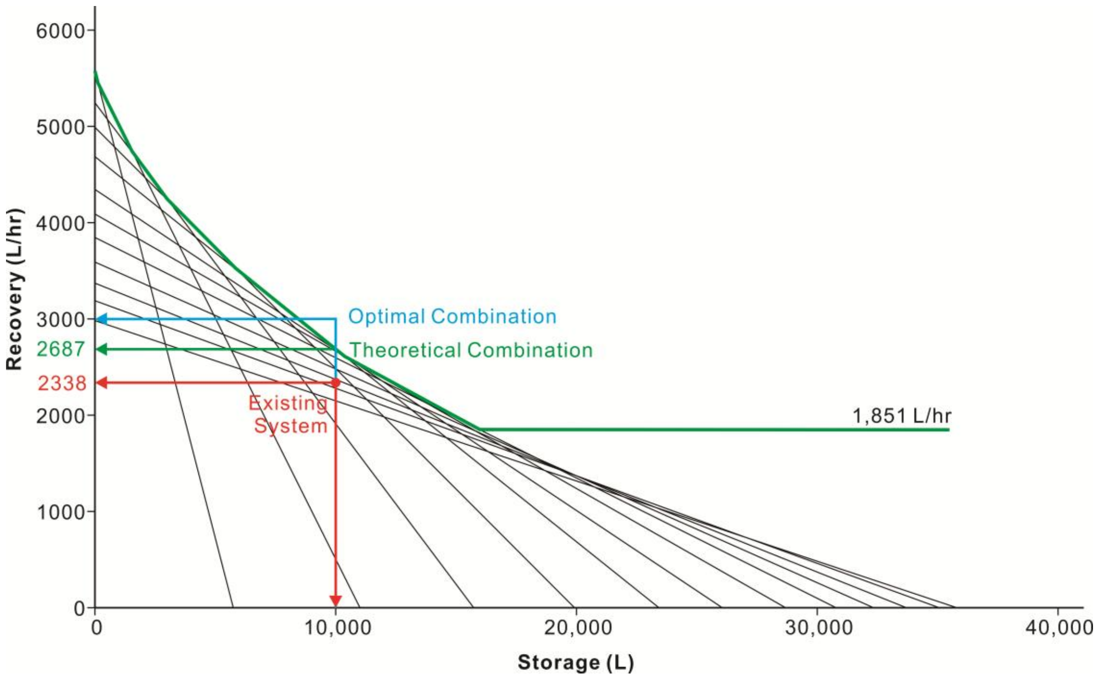
a) The storage make-up relationship is conducted by the following steps:

Step 1: Tabularize Storage / Make-up Relationship

A	B	C = B/A
Hour	Total (L)	Average (L/hr)
1	5775	5575
2	11025	5513
3	15750	5250
4	19950	4988
5	23415	4683
6	26040	4340
7	28665	4095
8	30765	3846
9	32340	3594
10	33705	3371
11	35070	3188
12	35805	2984

A	B	C = B/A
Hour	Total (L)	Average (L/hr)
13	36435	2803
14	36645	2618
15	36855	2457
16	37170	2323
17	37380	2199
18	38430	2135
19	40530	2133
20	43050	2153
21	43890	2090
22	44205	2009
23	44310	1927
24	44415	1851

Step 2: Draw the 'storage make-up ratio curve'



Step 3: Analysis

The present plant has a tank size = 10,000L
Hot water heater size = 150kW (may have already degraded)
Consider that the temperature increase = (65 – 10)°C = 55°C

Recovery rate can be calculated using the equation
$Q = mc\Delta T$
$150 = m \times 4.2 \times 55$
$m =$ 0.65 kg/s (2,338L/hr)

Plotting the combination of 2,338 L/hr and 10,000L on the make-up ration curve shows that the existing heater and storage combination is not sufficient.

If we consider maintaining the storage to be 10,000L (which is about 2 hours storage during peak hours), the theoretical recovery rate will then be 2,687 L/hr (0.75L/s).
The required heater capacity will be:
$Q = 0.75 \times 4.2 \ \times 55$
$Q = 173$ kW

It is suggested to have some spare capacity, thus a recovery rate = 3,000 L/hr (0.83L/s) is suggested.
In this case, the heater capacity = 192 kW (with around 10% spare capacity).

Depending on the capacity of heaters in the market, an additional ~42kW heater should be added to the existing system.