Heating Oil Graphs: Stats Class Edition

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1 Introduction

The EAC are currently working towards methods for tracking and analysing on-campus energy use. As part of this, I put a whole bunch of graphs together for consideration.

This document adds a few more, some of dubious quality, so that we (the stats class) can think about their merits. I've stripped out most of the commentary—you all now have to provide that!

Most of the data is taken from the Plant Ops heating oil excel spreadsheet. The "years" are, in all cases, financial years (July to June) which corresponds nicely with academic years and is, I think, the best cut-off point. The data goes back to 2000.

First, what does the overall consumption look like? See Figure 1.

A couple of other views: Figure 2 with a smoothed fit line and Figure 3 with an equation calculated to go precisely through the points.

Who cares about gallons? Dollars are the important thing. See Figures 4 and 5.

Some winters it's cold. Some winters it's really cold. Can we disentangle the building performance from the weather? Sort of. This is where "degree days" come in. Choose a baseline temperature, say 68°F. One degree day corresponds to a day with a temperature of 67°F. A day with a temperature of 20°F gives 48 degree days. For a financial year (or any other period, but we'll stick to financial year) define the efficiency to be the total heating oil used (in gallons) divided by the number of degree days for that year. As at least a first approximation, the idea is that this factors out the weather and we should get a graph that shows how well the buildings performed that year.

I've only been able to get three (financial) years back for the Marlboro weather station. But to whet the appetite for this type of work, Figure 6 graphs the efficiency over that period.

I have some more degree day data for North Adams that goes back ten years. I want to see how good a fit it is for the last few years at Marlboro and then, if appropriate, use it to give estimates for what the on-campus degree day totals were. I also have the data (both Marlboro and North Adams) for each whole-number baseline from 62°F to 74°F which will give some more flexibility.

Oil use has remained more-or-less constant over the last decade. However, there appear to be two competing trends that cancel out. First, we've been building, and these new buildings need heating. On the other hand, Plant Ops have been improving the thermal envelopes and replacing boilers with more efficient models. Figure 7 subtracts out the contribution from these new buildings (Serkin, Out of the Way, THC extension and the Library (Library deduction calculated by using the pre-build average for future years)).

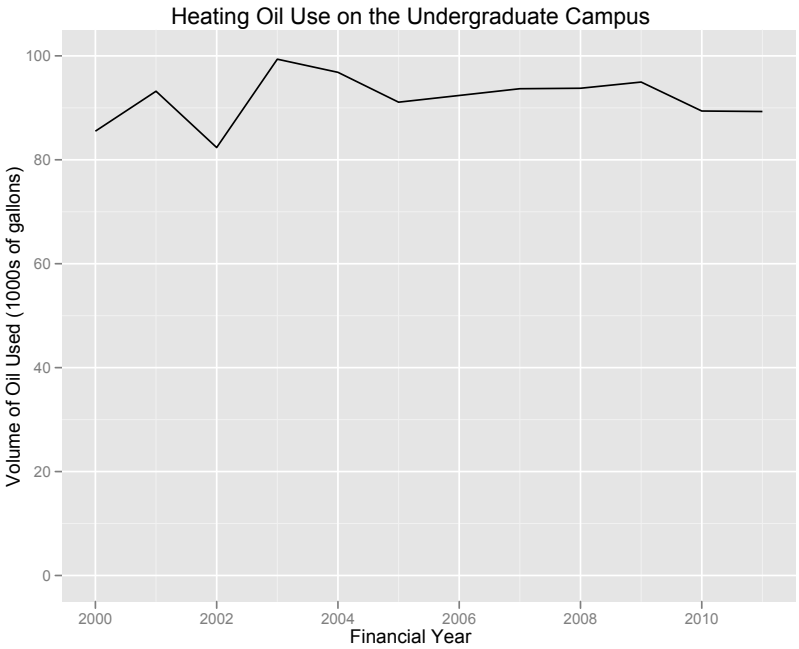
Here's what things look like building-by-building. Figures 8, 9, 10 and 11 give snapshots of the most recent financial year.

We can, of course, look at particular buildings or groups of buildings. See Figures 12, 13 and 14 for examples.

What happens when we try to combine both of the previous two types of data? That is, break down by building (or building type) for each year and display all of the years? Consider Figures 15, 16, 17, 18. 19, and 20.

We particularly care about what has happened since the retrofitting started (After the thermal audit in 2008 there has been massive amounts of remedial work done on the worst-performing buildings. The Admissions work over winter break is the latest addition to the list and can get added to this graph next year. Six dorms are also getting their basements brought up to scratch in the coming months). Figure 21 starts tracking that, looking at how buildings have changed in their heating oil use since work started.

Figure 1:



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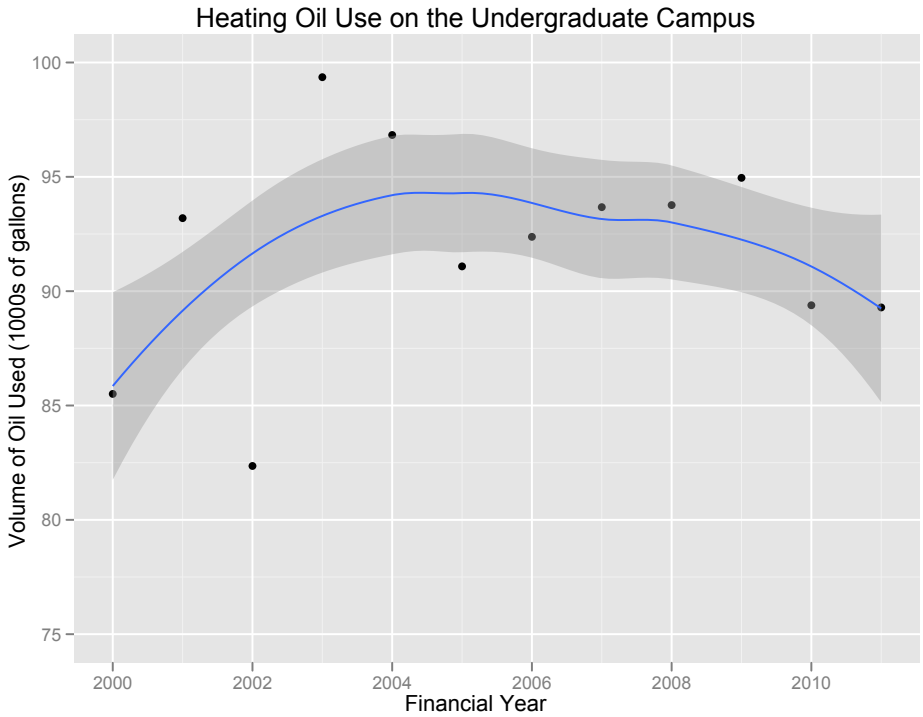

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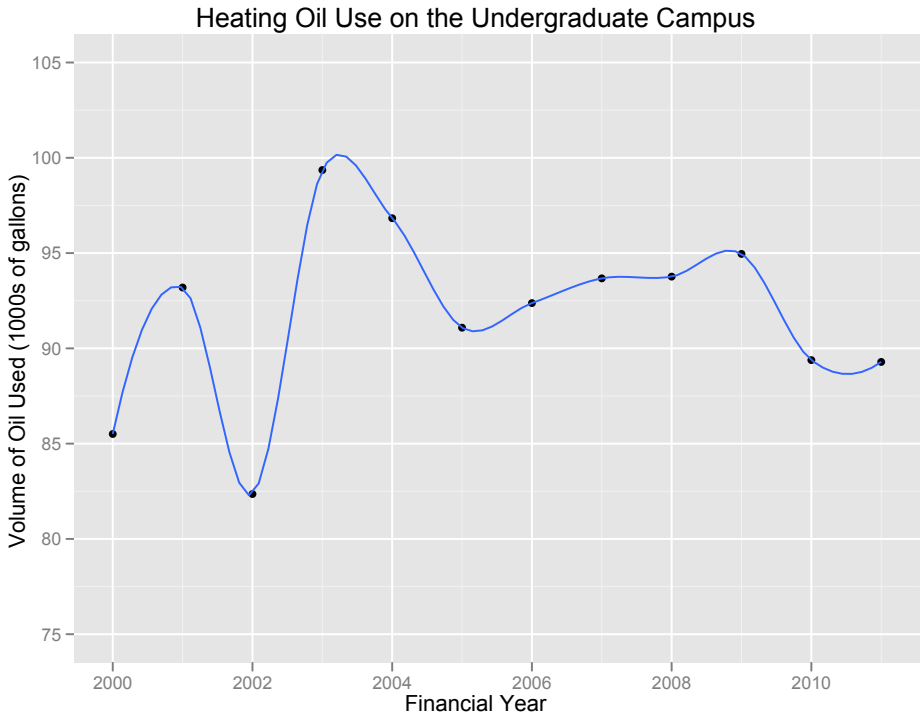

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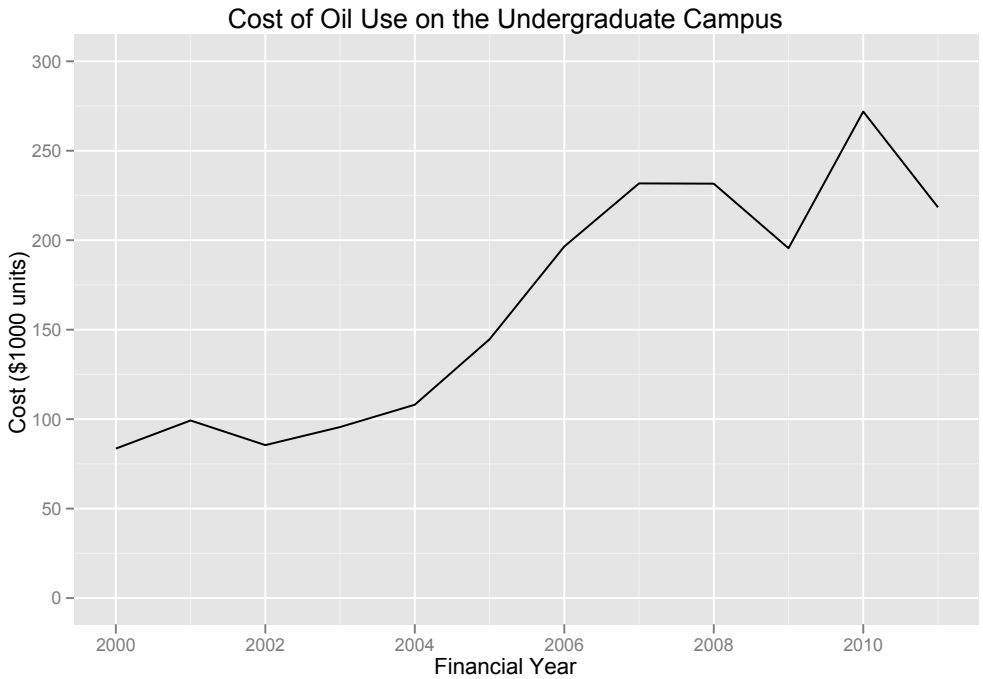

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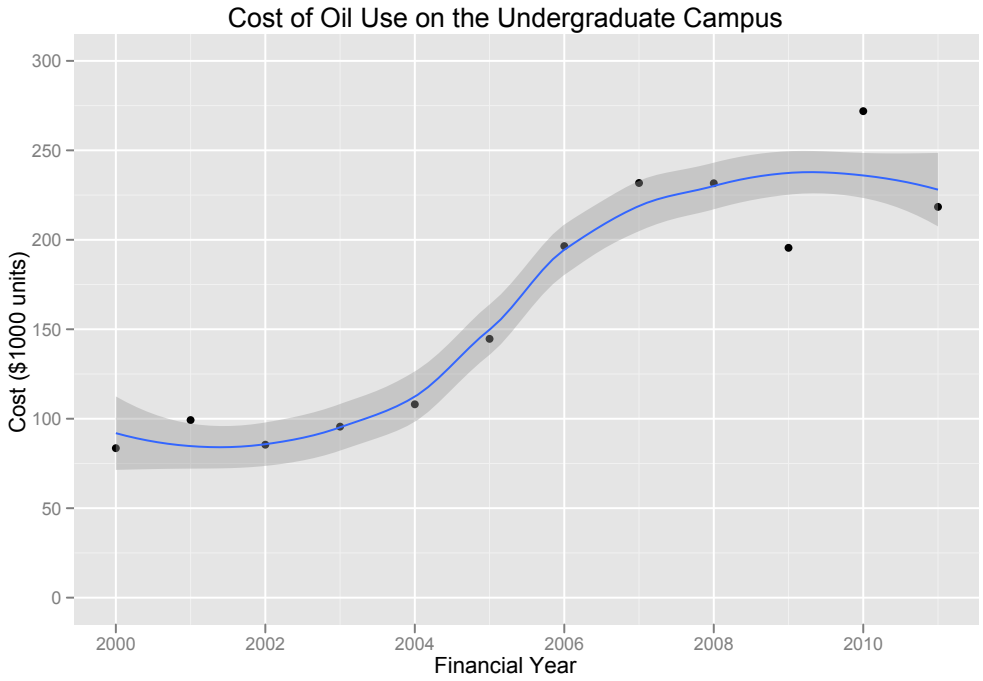

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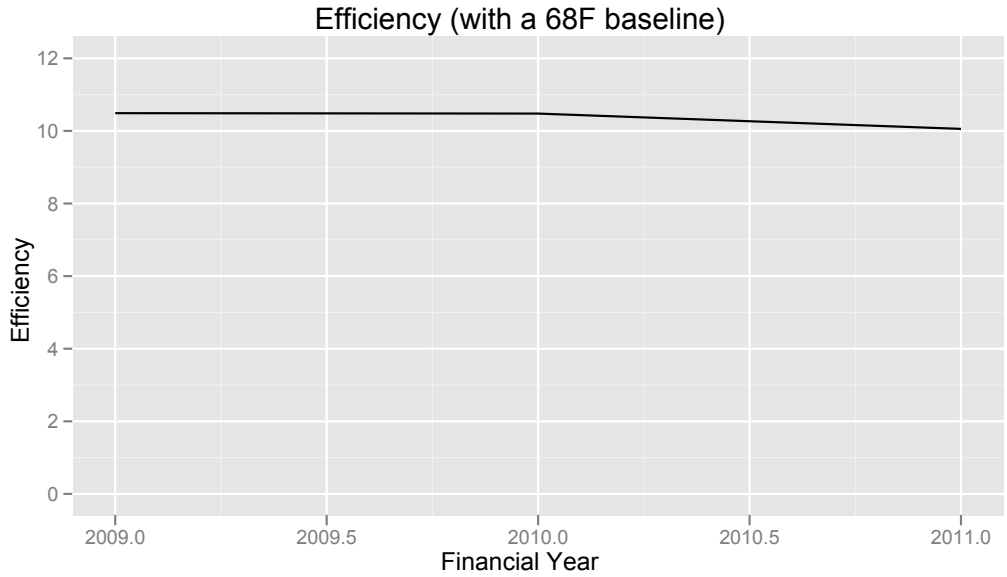

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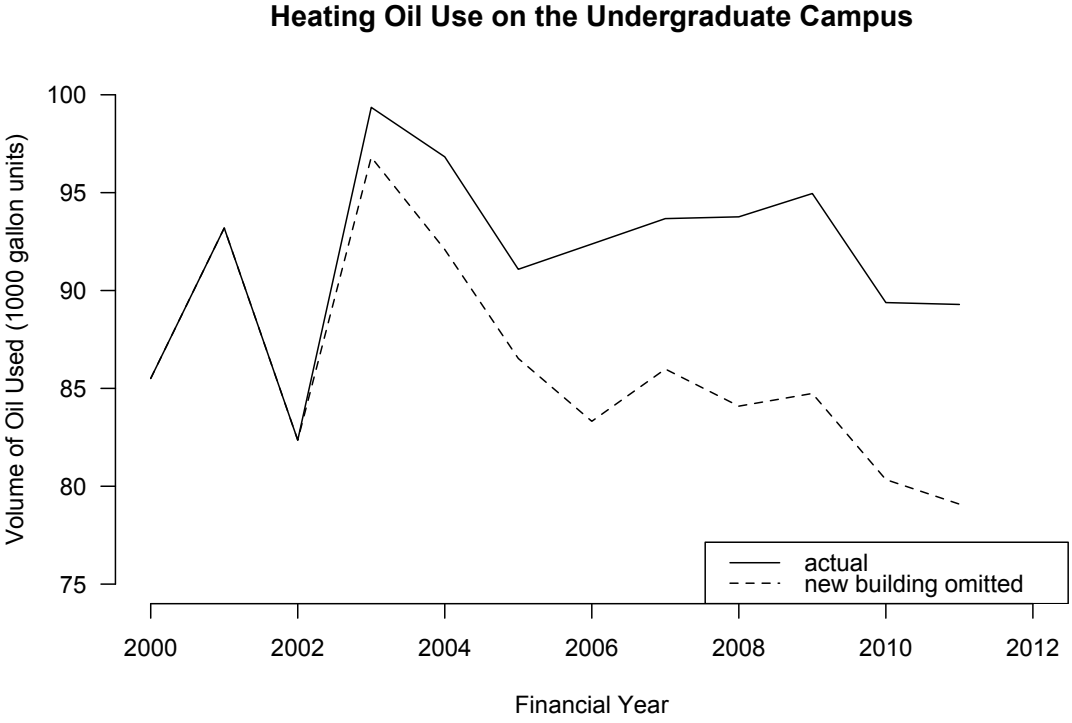

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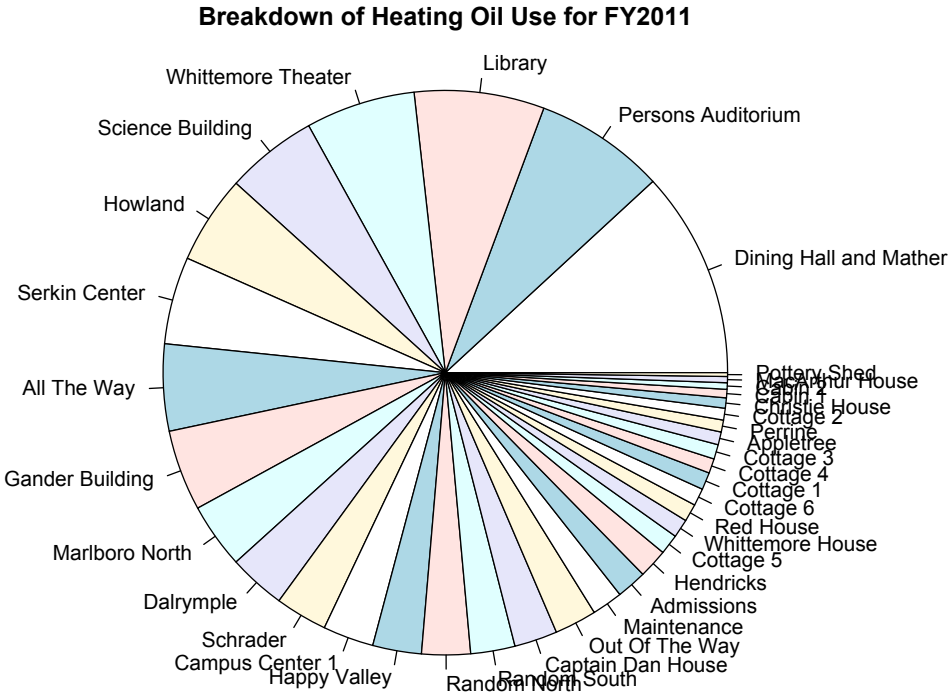

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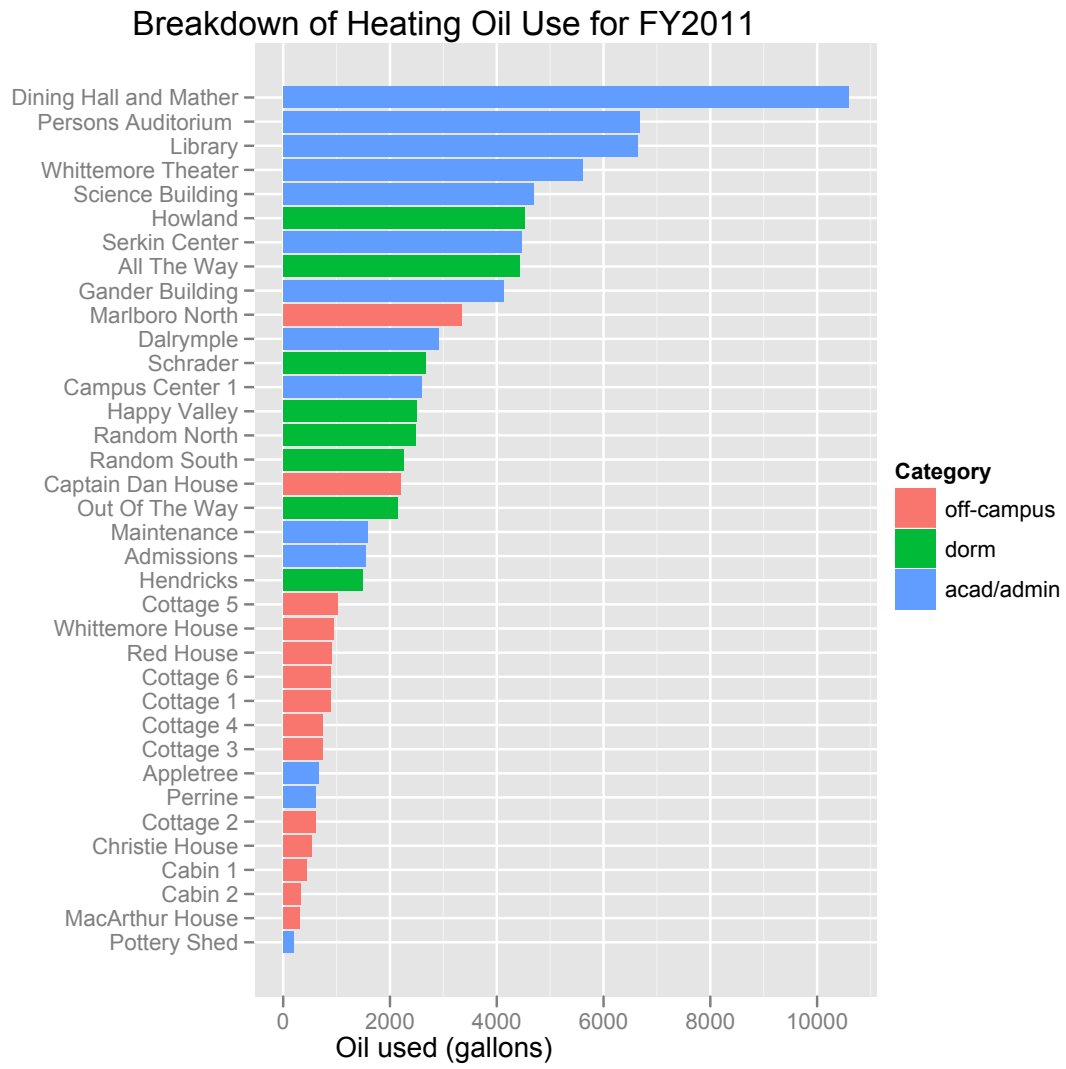
Breakdown of Heating Oil Use for FY2011
Dining Hall and Mather
Persons Auditorium
Library
Whittemore Theater
Science Building
Howland
Serkin Center
All The Way
Gander Building
Marlboro North
Dalrymple
Schrader
Campus Center 1
Happy Valley
Random North
Random South
Captain Dan House
Out Of The Way
Maintenance
Admissions
Hendricks
Cottage 5
Whittemore House
Red House
Cottage 6
Cottage 1
Cottage 4
Cottage 3
Appletree
Perrine
Cottage 2
Christie House
Cabin 1
Cabin 2
MacArthur House
Pottery Shed
0
2000
4000
6000
8000
10000
Oil used (gallons)
Category
off-campus
dorm
acad/admin

Figure 10:

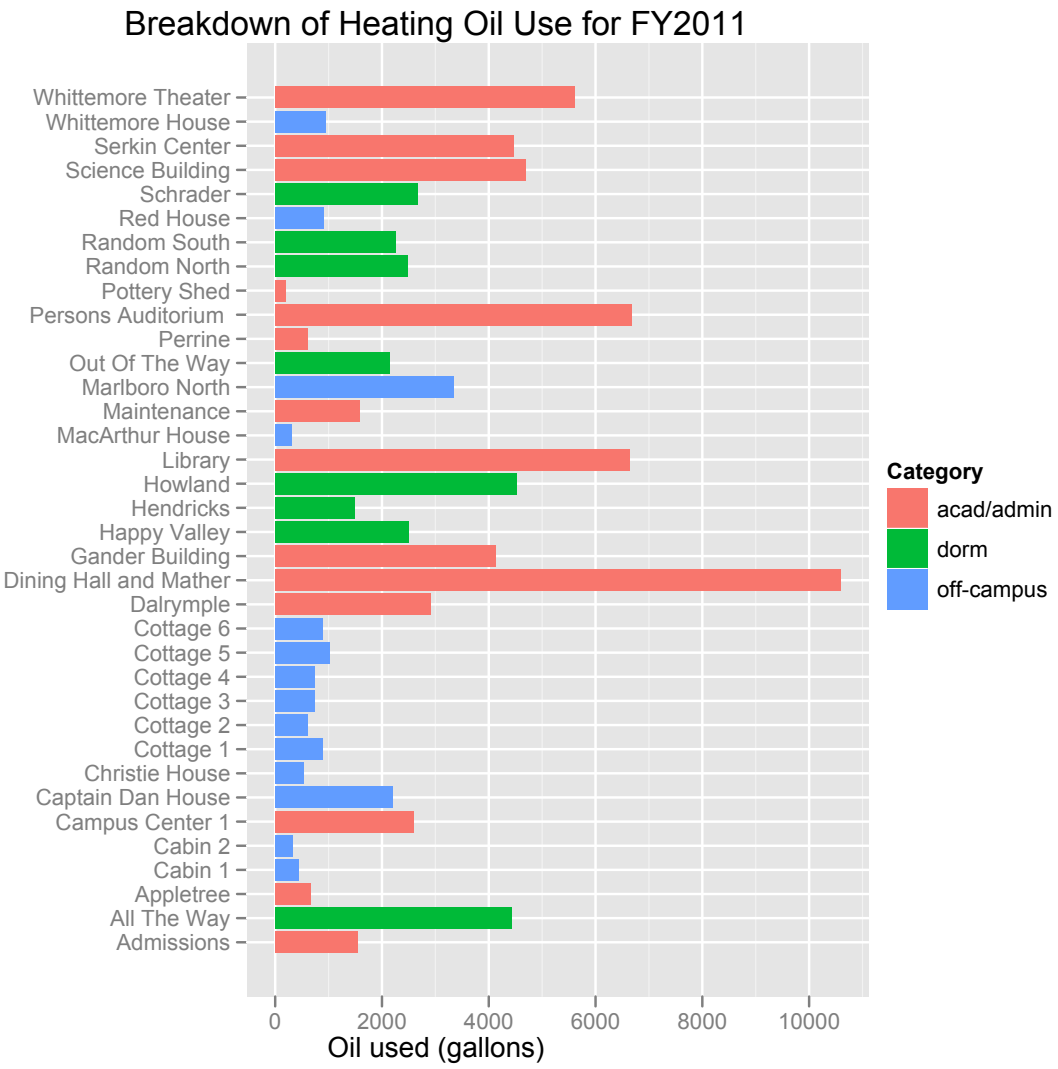
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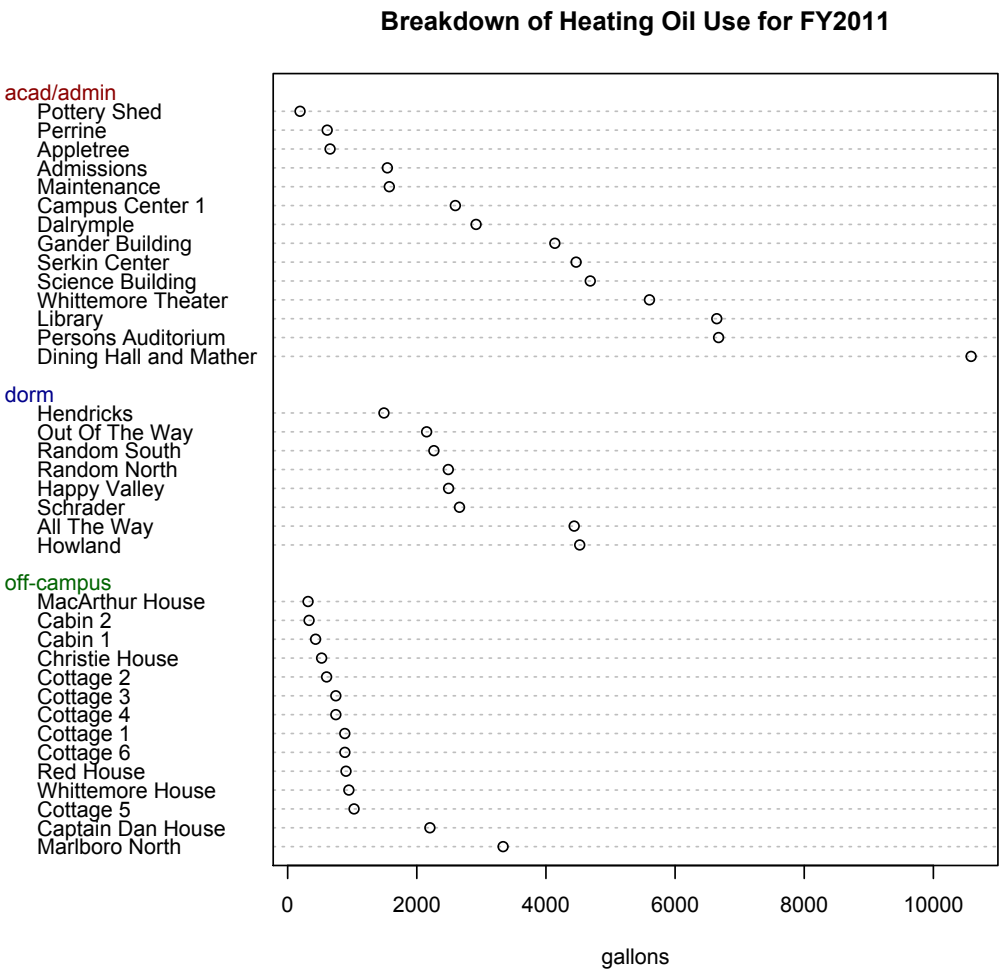
Figure 11: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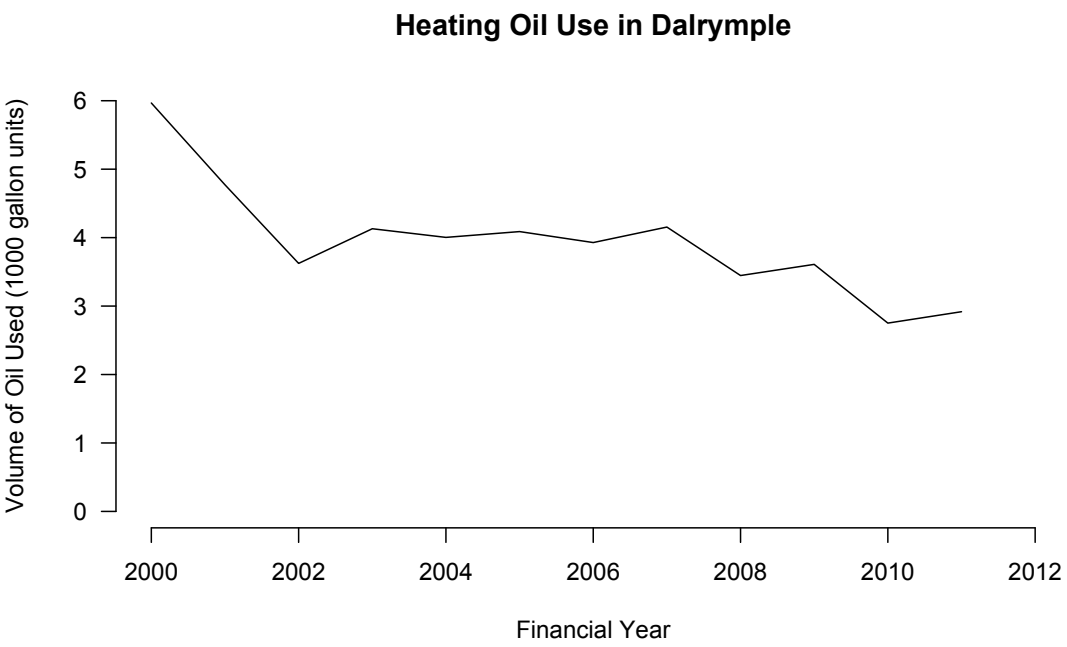
Red House
Whittemore House
Cottage 5
Captain Dan House
Marlboro North
0
2000
4000
6000
8000
10000
gallons

Figure 12:



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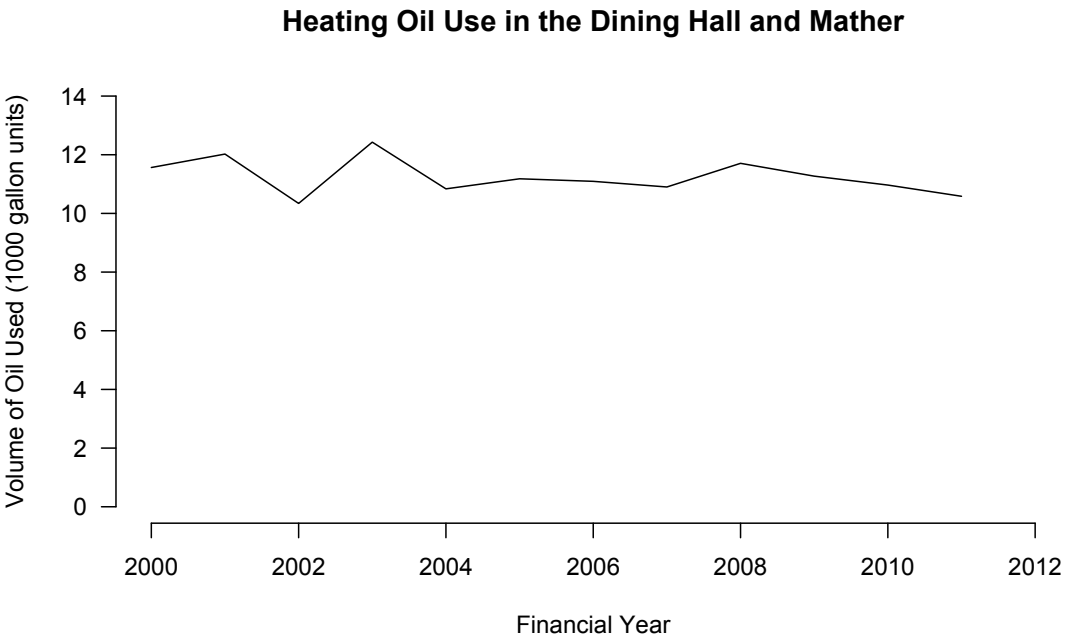

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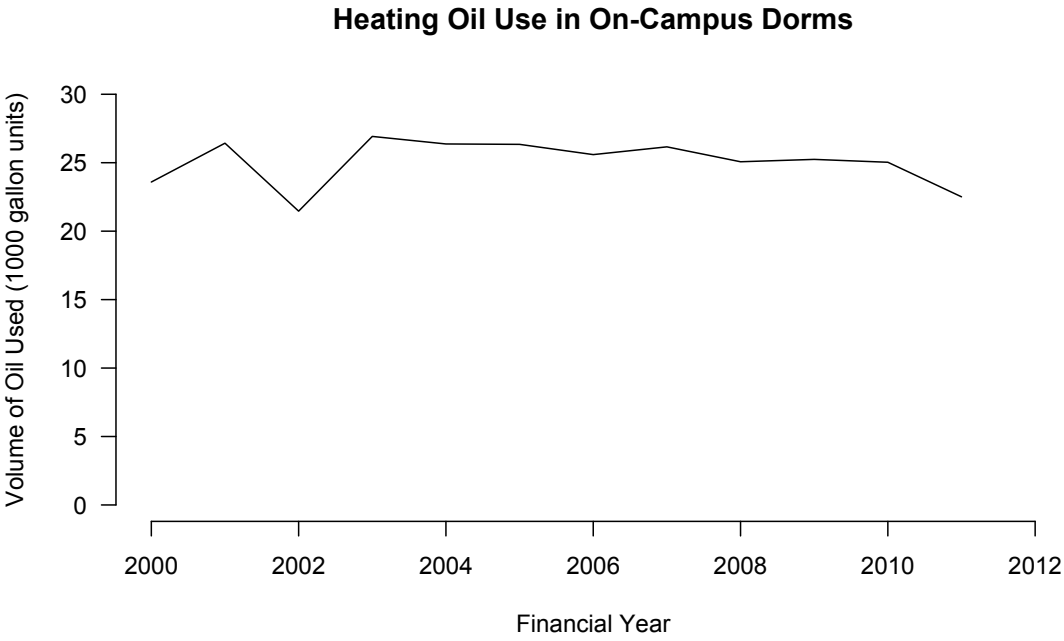

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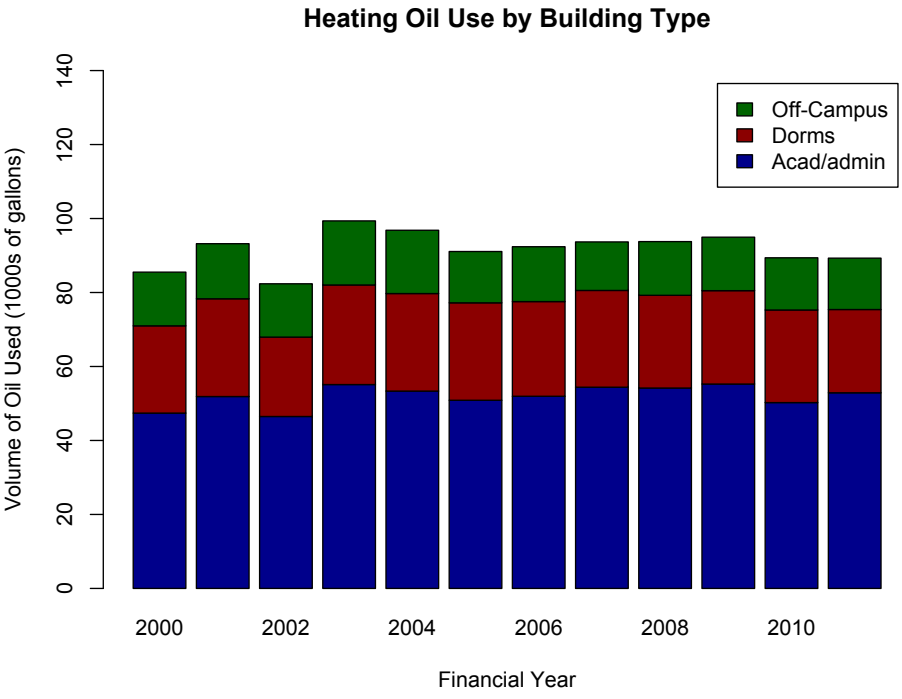

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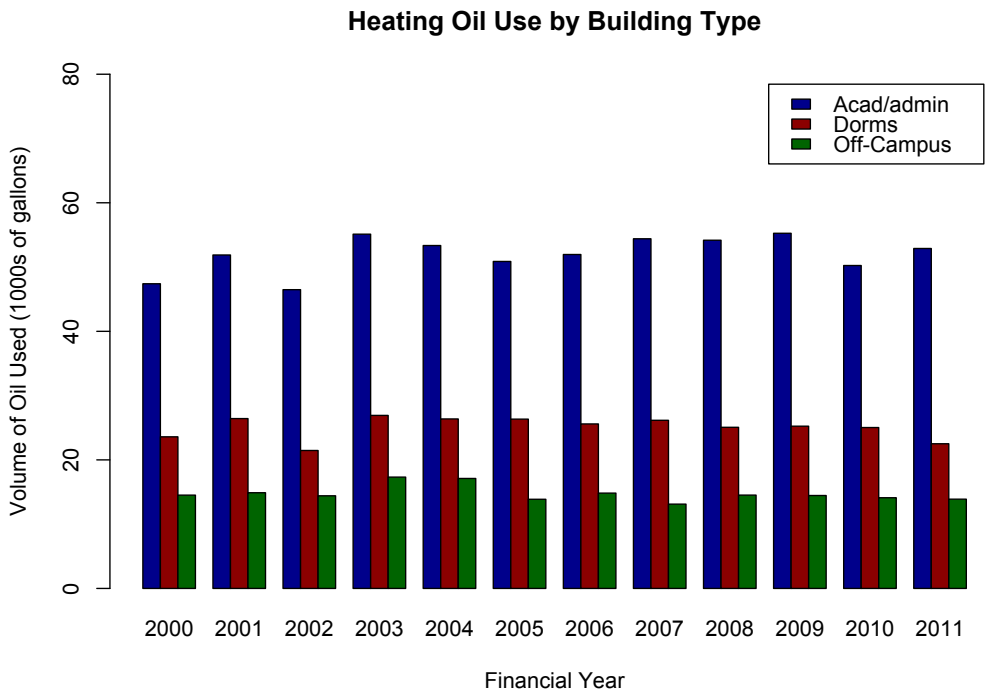

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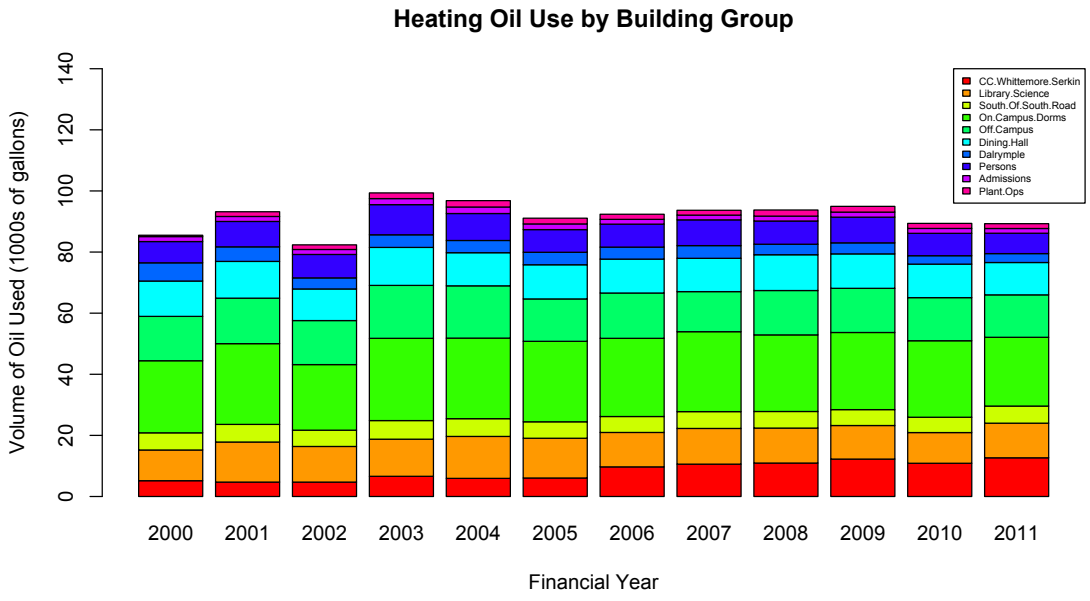

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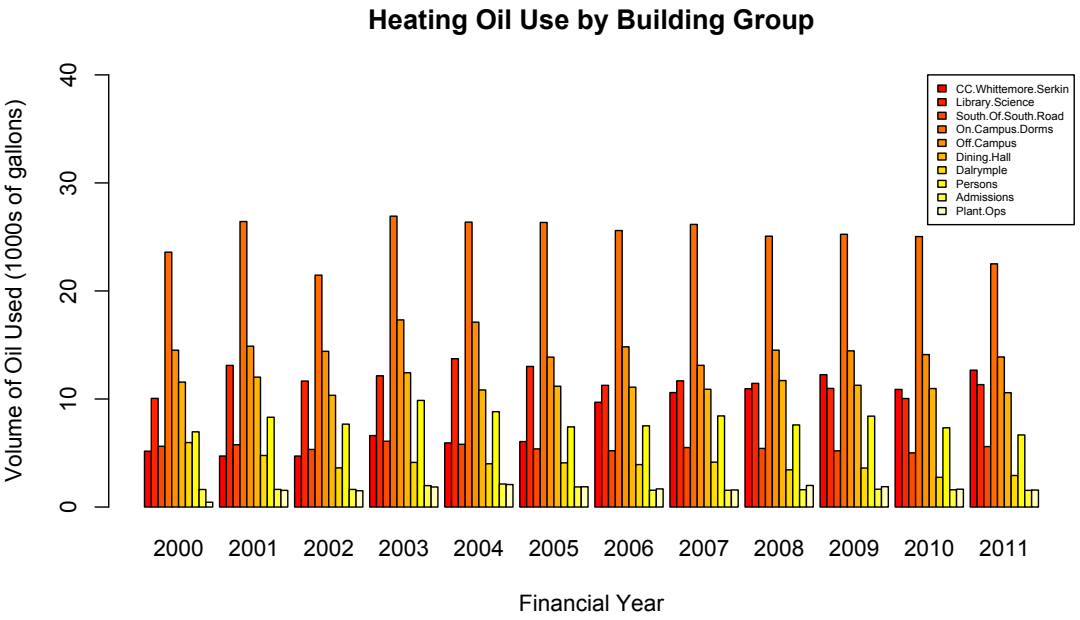

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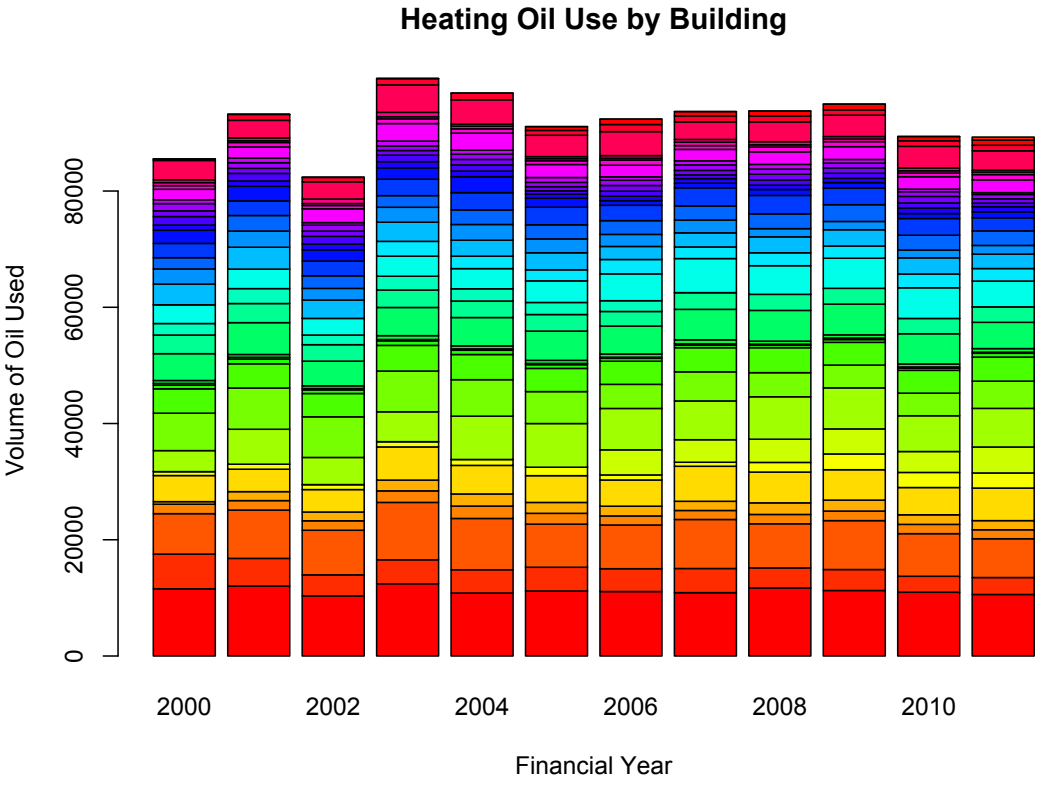

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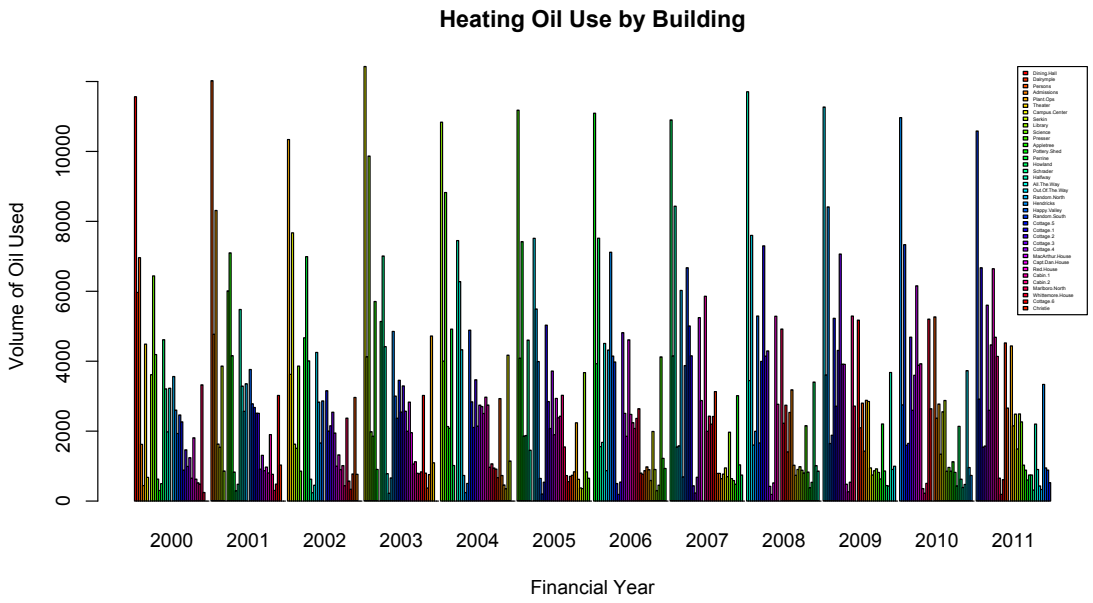

Figure 21: