The Lines Company
Capacity and Demand Charges
An Independent Peer Review

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Introduction

This is an independent peer review of *The Lines Company* charging system.

It was not commissioned, authorised or paid for by *The Lines Company*, rather my motive was to de-mystify what seemed to be a widely misunderstood charging methodology.

I attended a meeting in late February 2012 in Turangi, and found a wide range of people (at that time including myself !) confused by the charging system, and I have endeavoured to produce a document which will simplify and explain the system at a level that can be followed by the typical consumer.

I found *The Lines Company* customers, even those massively advantaged by the system, critical of it, and I felt that as a third party with no financial interest in *The Lines Company* (other than the fact I am a customer) I was possibly able to offer an explanation that would help customers and The Lines Company alike look at the systems and methodology in a clearer light.

Of necessity, I have not endeavoured to cover all possible installations and and scenarios, and simplification of anything always means that some level of detail is lost.

I hope that those who read this document will appreciate when reading my sometimes less than technically precise explanations, that I intend to enable a wider understanding of the principles, rather than an accurate physics lesson.

This is a peer review that is intended to be read and understood by all, not just engineers.

Its fair to say that I generally endorse the capacity and demand charging system adopted by *The Lines Company*, but I have some reservations that I describe in the relevant sections.

I hope this brief report will assist members of the community understand the charging system, and that they will be able to understand and therefore manage their energy usage to best advantage, and that *The Lines Company* will treat my criticisms as constructive.

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General Background

As a rule of thumb, **energy** companies charge you for the energy you use, and a separate **lines** company charges you for the power-lines, transformers, and the other equipment that is required to deliver the energy to your home.

Its not a level playing field.

A lines company that supplies 10 houses at the end of a 20km power-line pretty clearly has an uphill battle to charge the same as a company that supplies 100 households in an apartment block.

The charging methodology that a lines company chooses has a considerable effect on individuals accounts.

But it has a limited effect on the overall cost of running the network.

This document does not attempt to measure how efficient or well run *The Lines Company* is, discussion of this is limited to a brief look at system performance as measured by the number, and duration of system failures.

The Lines Company is unusual in that it bills its customers directly.

Other lines companies bill your energy provider, who simply lumps the line charges in with its energy charges.

The Lines Company also uses capacity and demand metering (as well as a calculated version of this) to a much great degree than the norm.

This contributes in no small way to the current confusion, and widespread concern about The Lines Company.

Capacity and Demand charging

Most lines companies charge a **fixed** rate, plus a rate based on the amount of **energy** you use. *The Lines Company* have chosen a more complicated system, based on **capacity** and **demand**.

The technical bits

For our purposes, Power is measured in watts, or thousands of watts which we write as “kW” and say as “kilo-watts”

To measure energy, we have to look at how much power you are using, and then look at how long you use it for.

So a 100 watt lamp uses twice as much energy in two hours as it does in one hour. But its still a 100 watt lamp.

It hasn't got any more powerful, its just used more energy as it is on longer.

This gives us our energy metering system which is in kilo-watt hours or kW/hrs, also called **“units”**, which is the term I use in this document.

The Village of Powerville – comparing charging systems.

Consider a theoretical village where there are 100 homes, and it costs $70,000 each year to maintain, and update the power lines, transformers, and other assets that allow the village to have a reliable supply of electricity.

That's an average of $700 for each home, and the charging system the lines company chooses will have a massive effect on each consumers bill.

Lets have a look at the different charging systems that may be used.

Fixed charging or 'daily charges'

If the lines company charged a fixed annual rate of $700 to each house, the books balance.

But the elderly pensioner who lives on her own and hardly uses any electricity is paying the same as the mansion next door with a butler, 6 nannies and 5 spa pools.

Low energy users are subsidising energy gluttons.

Energy Based Charging

The entire village also uses 700,000 units of electricity each year, around 7000 units per home.

So one solution is to say each unit of electricity used is charged at $0.10. This will return $70,000 and once again the books balance.

But half the homes in the village are only occupied at weekends.

Weekend customers only use energy two days a week, so they use 2/7^{ths} of the energy that the full time residents use.

So they only pay 2/7^{ths} of the lines charges.

But as the power-line into the village had to be built to cope with all customers, its twice the size it need be if it only supplied the full time residents.

The full time residents have to pay for the installation and maintenance of equipment that is essentially there to meet the needs of weekend residents.

The full time residents are subsidising the weekend users.

Capacity and Demand Based Charging

The Lines Company have decided to use a system based on **capacity** and **demand** . In our theoretical village, each customers individual capacity and demand are measured or calculated, and that's how the the lines charge is allocated.

These ideas are first cousins, but one was born first.

Capacity, is the ability of the network to deliver electricity to the village, and each home in it.

Its quite reasonably thought of as the thickness of the wires to your village and home.

If the wires are not thick enough, it becomes impossible to push enough electricity through the wires without them being destroyed.

It is capacity that limits the amount of electricity that can be delivered, so lines companies try to anticipate how much capacity to provide in each area, and right down to your individual home.

Or to use a transport analogy, think of capacity as the number of seats in your family car.

You only get a new one every 50 or 60 years, so you have to take a guess as to how many kids, dogs, relatives and mates you will need to carry in the next 50 years and buy a car that meets your needs.

Demand, is the amount of load you actually put on the network.

To use our car analogy, you may have purchased a 6 seater car, that's your capacity.

If the most people you ever carry is 4, that's your demand.

But its a one way street. The day you want to carry 8 people, you can't.

So compared to daily charges, or energy charges, capacity and demand charging will :

- Lower the proportion of the network costs paid by low energy users
- Lower the proportion of the network costs paid by full time residents
- Increase costs to those who use large amounts of energy at times when the network is heavily loaded.
- Increase costs to those who use a large amount of energy sporadically.
- Will usually decrease costs for users of energy who manage their load well, and keep a low demand and capacity charge.

The Engineers Dilemma

Power system assets last a long time.

If well maintained they may last more than the lifetime of the engineer who designed them.

So when its time to plan for the power supply to a village or town, the engineer has a lot to consider.

He has to make sure he puts in enough capacity.

Otherwise he won't be able to meet demand.

On the other hand, if he puts in too much capacity, it will never be used. But everyone will have to pay for it to be installed and maintained for years to come.

Should he feed the town with one big power-line and take the risk of it failing, or use two smaller ones, but be up for two lots of installation and maintenance costs ?

The guy on kidney dialysis will want the two power-line solution, but will the young family with the big mortgage ?

Will the computer, blow dryer, heat pump and dish washer be invented after we put in our line, and if so how will they effect our calculations ?

This is another reason for demand and capacity charging.

If people voluntarily modify energy usage patterns to stay within the design parameters of a network that may have been designed and built fifty years ago, there is no need for a massively expensive upgrade, or at least it can be deferred and the cost spread over many years.

We have a look later in this document at the effect this has had on load patterns for Turangi.

Areas of concern.

Demand and capacity charging can catch out the unwary, and you are stuck with the new price for an entire year.

Unmanaged peak use of energy can result in a large lines charge, even for a user who on average takes very little energy from the network.

Large industrial customers can use automatic methods if they choose to help manage this, for example they might turn off cool stores when operating big loads, but this is beyond the means of the domestic consumer.

Plus, the small customer may be disadvantaged by one off events that require heavy peak electricity use.

The extended family staying for a week after Nana broke her hip, a faulty thermostat or simply that unnoticed oil heater in the back bedroom that no-one thought to switch off.

The Lines Company have taken some steps to address this.

Consumers will be able to get low cost meters that warn when they are in a peak period, and allows them to track their usage.

Additionally they have moved from measuring the peak load of a customer from a single three hour period to the average of the top six two hour loads.

This appears to be a reasonable compromise.

On one hand, the consumer should not be at excessive risk of a single unplanned event causing them to have a blow-out in next years lines charges.

But the basis for demand and capacity charging is not excessively diluted by the new averaging either.

At the moment demand meters are not installed at all customer premises.

The “formula” is used to obtain a calculated demand figure.

This limits the ability of customers to minimise power accounts effectively, as their individual consumption is not truly reflected by the formula.

This creates a pseudo energy charge which may advantage those that do not manage energy well, at the expense of those that are careful.

This is being addressed by the roll out of true demand meters.

The Lines Company Charges.

The *Lines Company* charge you for :

Control Fee.

This is for the ripple control relay that *The Lines Company* use to switch your water heating on and off.
This fee is around $1.58 per month.

Meter fee.

This is for the meter that *The Lines Company* use to determine your energy consumption. You may need one, or two, depending on the way your home is wired.

This is around $4.92 for one meter, or $7.43 for two.

Your energy retailer may charge you a lower rate for energy that the power company can switch on and off using ripple control, so if you have two meters, one may be dedicated to water heating and other loads that are under the control of the ripple relay.

Network charge.

This is a charge based on the **capacity** of the lines that feed your home.

Remember the idea that you can think of it as a charge based on the thickness of the wire that delivers power to your home, or the number of seats in your car.

The thicker the wire, the more power it can deliver, but the more it costs to install and maintain.

The charge reflects the minimum *The Lines Company* think you need rather than the actual capacity of the wire, which in general will be greater than you actually pay for.

In practice *The Lines Company* charge you twice the actual **demand** of your home or 5kW whichever is the greater.

This charge varies between $3.61 and $6.95 for each kW of capacity, depending on where you live.

Demand charge.

The Demand charge is similar to the Network (capacity) charge, except that it is based around the actual energy that you use, at times when *The Lines Company* network is reaching its limits.

At these times, ripple control is used to switch off water heating and other loads, that in most cases can be turned off without any inconvenience to the customer.

The Demand charge is calculated by looking at your highest actual energy usage, when ripple control is being used, and the network is under its worst case loads.

Your energy usage is measured, and a running total of the energy you have used in the last two hours is looked at.

The average of the top – six periods forms your peak, and as it was measured over two hours, it gets divided by two, to get your peak hourly demand.

Remember the energy you use over a two hour period is used to determine your peak usage.

So plugging the jug in will only move the peak a little, as it is only on for 3 or 4 minutes out of the two hours.

But leaving the dryer or dishwasher on for the entire two hours will include these loads in your peak.

The idea is, to encourage you not to use these appliances during peak periods.

The demand charge is between $1.65 and $8.06 per kW/hr depending on where you live.

The formula

The Demand Charge is based on demand as measured by “demand meters”.

But many older homes don't yet have these meters, so a system has been developed to estimate the demand of homes that only have old-fashioned kW/hr meters.

These meters are only read on a monthly basis, so they simply can't provide the information required.

But a mathematical relationship between actual monthly usage and peak usage has been established that is being used in the mean time.

This is called **the formula.**

How **the formula** works.

First it is necessary to find the actual energy consumption of your home.

The information from three months usage read during the peak months of June, July, August and September, is used.

As the meter reader cant get to all homes on the same day the meter reader will read your meter 4 times but only three full months (92 days) will be available for the calculation, from your July, August and September meter readings.

Once the energy usage over the three months is known, its bunged into the formula to estimate your “demand” and of course your “network charge” which is based on twice your demand, or 5 kW, whichever is greater.

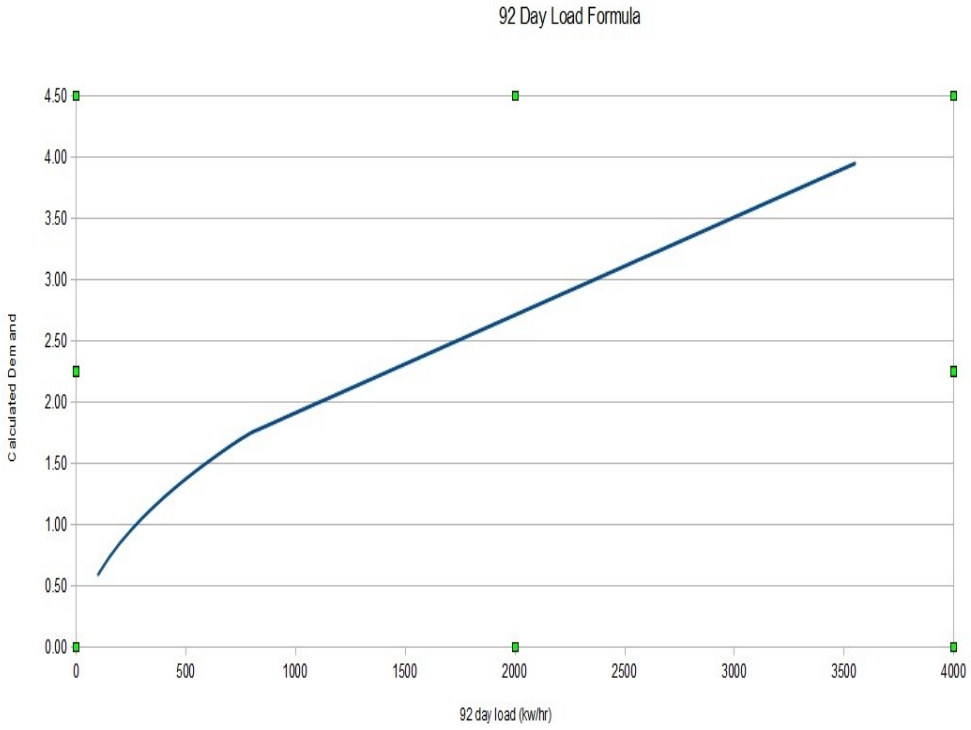
The formula look complicated, but essentially they are just a mathematical way of describing a graph.

So I have printed the graph here, and you can use it to determine your calculated demand.

For example, if you used 1000 kW/hrs in the 92 day period, *The Lines Company* would assess you as a 1.9 kW/hr demand.

(If you are in a holiday home, the minimum formula rate is 2.1 kW/hr.)

The 92 Day Load Formula



Adding it up.

(a) Find your demand using the chart.
If you are in a holiday home your demand is calculated demand or 2.1 kW/hr, which ever is greatest.
(b) Find your capacity by using 5kW or twice your demand whichever is larger.

Add meter and relay fees and you have your fixed charge.

Energy Company Charges

Remember that as you have paid *The Lines Company* directly for lines charges that you won't be invoiced these by your electricity (energy) retailer.

Other issues

Disconnect or dismantle

The Lines Company have a policy of continuing to charge full lines accounts for properties that are disconnected from the electricity supply, but have not had the meters, relays and even sometimes feeder cables removed.

The issues for The Lines Company are that in an area with a large number of vacant property, or seasonably occupied property, a large number of customers could be disconnected from the network for considerable periods of time.

The resultant costs of the network would have to be spread to those consumers in the area that do still have a connection.

For example, in our theoretical village, if we need $70,000 from our 100 homes, that's $700 per year per home.

But if 1/3rd of the homes were vacant, and paid no lines charges, the occupied houses would have to find $1060 each, a full 50% more.

Once a connection is dismantled, it is not always able to be easily restored, especially in areas where the network is at or nearing full capacity.

New customers to the network are often surprised and dismayed to find they have to pay money owing from previous property owners before they may connect .

This is an increasing problem for property purchasers, who find after buying a new property, that the Security Alarm, Heat Pump and DVS system have not been fully paid for, as well as electricity lines charges are outstanding.

Real Estate agents, and Lawyers doing conveyancing are gradually coming to grips with this.

Lines charges for unoccupied connections are of clear benefit for those occupying the houses in our village, and quite the reverse for those with unoccupied premises.

Opinions on the validity of the policy appear to fall along the same lines.

Other influences on the cost of supply.

The cost of operating a lines network depends on a wide range of factors.

Considering our Village.

If the village were situated at the end of a 100km power-line, the cost per customer would be much greater than if it were only 1 km long.

Similarly, if the line is operating at its maximum design load, or it is old, and hasn't been maintained, then it will cost more to keep serviceable than a well maintained or newer line.

This principle applies to all the transformers, voltage regulators, switchgear and so on that the network relies on.

If the population of the village halved, the cost per consumer would inevitably have to rise as well.

If the population doubled, then the cost per customer would drop, as long as the existing infrastructure could meet demand.

Of course if it cannot meet demand, then new investment needs to be made and so yet another upward pressure on prices arrives.

Lines companies can react to these price pressures in a number of ways.

One is to leave the lines charge pretty much where it is, but defer maintenance and accept a higher rate of network failure.

This approach had been followed to some extent by all New Zealand lines companies to some degree or another, but in our area it was applied with some enthusiasm !

To make another transport analogy, we could save money in the short term by not changing the oil, or replacing tyres and brake pads as they wear out on our car.

Eventually however, we will face expensive repairs, and need to find the money for four tyres all at once, and if our demand has kept rising, we may even be faced with having to purchase a second vehicle.

Having to catch up with deferred maintenance and investment is a large factor influencing the increase in prices in *The Lines Company* Area, with price increases being required simply to put the house in order.

In the eyes of many customers, capacity and demand based charging are associated with price increases.

In fact, capacity and demand based charging are a mechanism to minimise price increases.

Reducing the need for new infrastructure

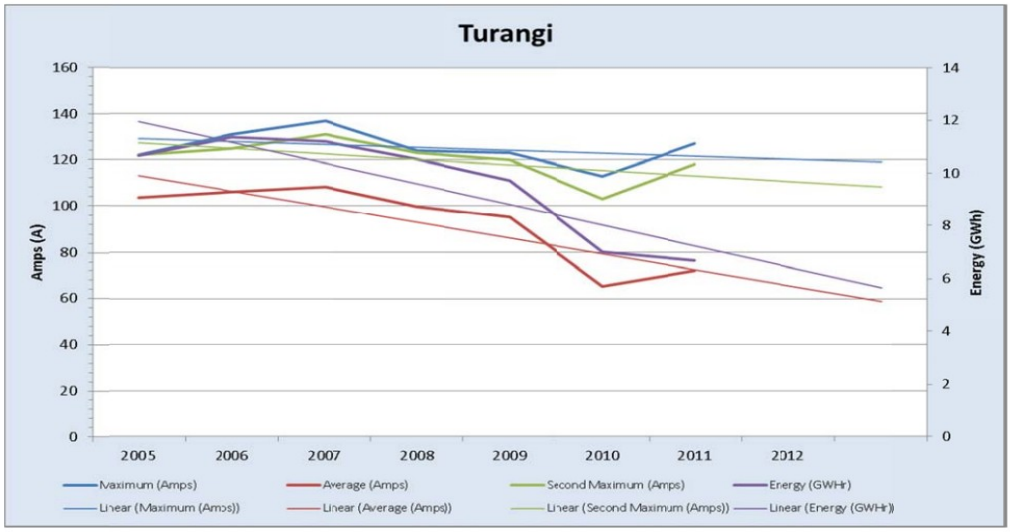
Charging for capacity has the theoretical advantage that customers will voluntarily modify energy usage patterns.

This has several major advantages for the lines company, and the consumer.

If usage patterns change, so that existing infrastructure can cope, then there is no need for new, and usually expensive investment in new lines and equipment, or at the very least it can be deferred.

This helps keep a cap on prices.

I looked to see if I could find evidence that capacity and demand charging has reduced peak demand, or at least the growth in demand.

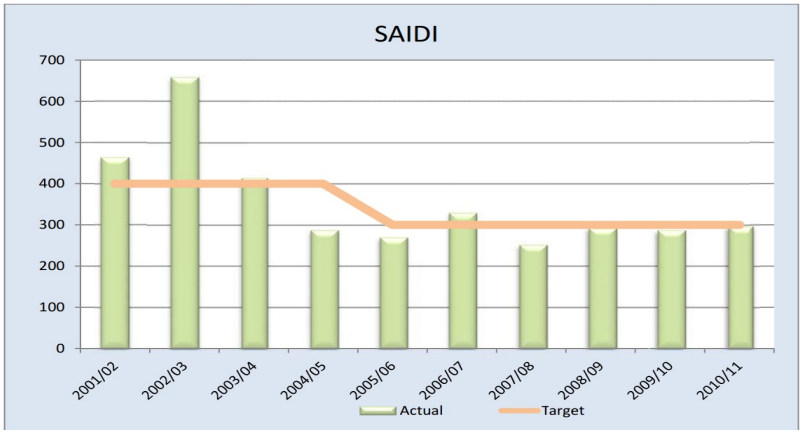


There seems to be some evidence that demand charging has been effective, although a recession and other factors may have had a considerable and hard to predict influence.

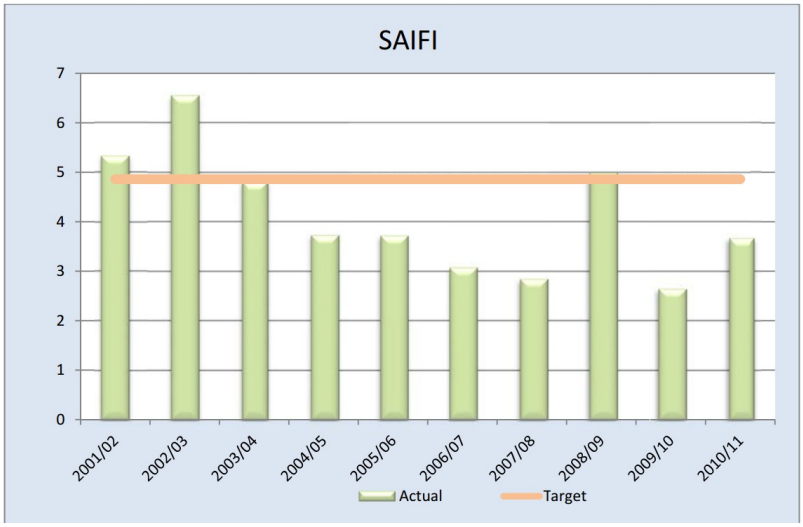
Has the performance of the network improved ?

Lowering demand and increasing expenditure on plant, equipment and maintenance should be be having a positive effect on network performance. A simple measure of this is to look at the average duration of system outages, and how often they occur.

This chart is a measure of the average duration of system outages, and the chart underneath if a measure of how often these outages occur.



Both show the network has improved and is performing to target.



Just as under maintaining assets does not cause instant failure, bringing maintenance back up to a prudent level does not provide instant reliability.

Terminology

I have used the terms “Capacity” and “Demand” throughout this document.

But my invoice calls them “Network” and “kW Load TK”, and then there is also a “Transmission fee TK.

The website talks of “Load charges”, and its all very confusing to reconcile.

I'd suggest a review of terminology may help consumers understand things a little better.