

# MISG Project: Optimal Hedging Strategies for Australian Electricity Retailers

## About Integral Energy

The National Electricity Market (NEM) features a floating spot price for the wholesale purchase of electricity from the pool. Short-run variation in supply and demand causes fluctuations in the pool price. Exposure to the uncertainty of future pool prices, also known as pool price volatility, is referred to as market risk. All electricity retailers are subject to market risk when trading in the NEM, which to date has only been related to contract customers.

Energy trading involves entering into financial derivative contracts with counterparties, such as generators, financial institutions and other retailers. Contracts are selected to best implement the hedging policies established by the electricity retailer, in order to immunise the retail business against exposure to pool price risk.

The existing portfolio compositions are determined heuristically (trial and error), with the intention to minimise Integral Energy's exposure to wholesale electricity price volatility. In the long term, a more efficient portfolio structure could be determined using portfolio optimisation theory.

The aim of this project is to explore approaches to obtaining "optimal" hedging strategies for controlling the risk Integral Energy is exposed to using a given set of derivative contracts.

## Problem Outline

### ***Commodity Risk in the NEM***

Electricity retailers provide electricity to consumers at prices which, on time scales of the order of a year, are fixed. They obtain this electricity from a pool where the spot prices vary, often dramatically, at half hourly intervals. It is not untypical for there to be spikes in the spot price, at which the retailer must buy, where the half hourly price changes by a multiplicative factor of the order of 100 during peak periods.

The retailer is therefore exposed to significant market risk over time scales of the order of year in that the price at which they sell is fixed but the price at which they buy may, and does, fluctuate - often dramatically. The two types of market risk are Value at Risk (VaR) and Earnings at Risk (EaR).

VaR is defined as the maximum loss incurred by the trading department, for a given time interval and confidence level, when attempting to liquidate a portfolio within a set, relatively short, time period. EaR is defined as the maximum loss incurred by the trading department, for a given time interval and confidence level, if the current committed portfolio is fully exposed to the volatility of the pool price.

In order to protect themselves against this risk, the retailer typically enters into derivative contracts (forwards, swaps and caps, for example). A derivative contract typically covers the retailer for a small number of days (say 48 half hourly periods)

and must be set up well in advance of the short period which is actually being hedged; a typical hedge having to be set up on the order of a year in advance.

Most retailers have models which predict (usually reasonably accurately) the expected values and random variation about the expected value of the demand and spot price out to the times relevant for hedging. (In the case of Integral Energy, one such model is the TLP (Temperature-Load-Price) model.

**Example: ETEF Roll-Off**

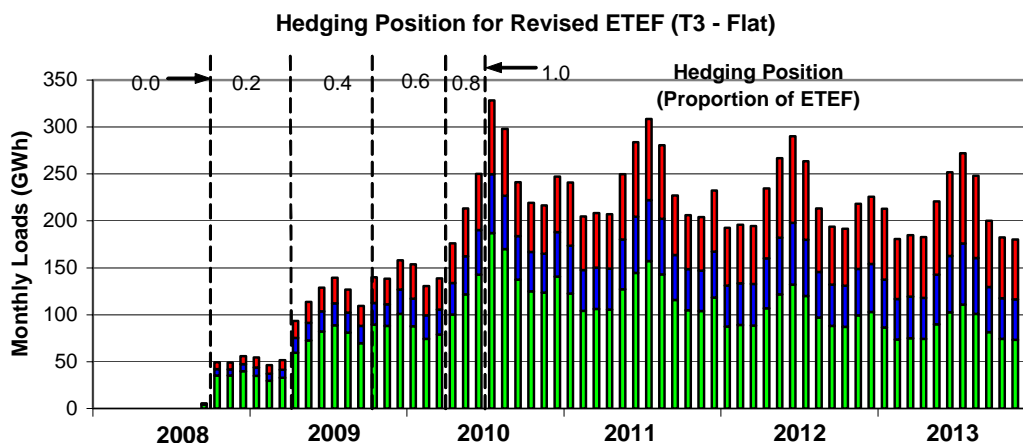
Created on 1 January 2001, the purpose of the Electricity Tariff Equalisation Fund (ETEF) is to manage wholesale electricity pool purchase price risk for franchise retail suppliers in NSW, arising from the supply of electricity to small retail customers at default tariffs. The tariff levels are determined by the Independent Pricing and Regulatory Tribunal (IPART).

Small retail customers have the right to enter into an individual contract, or stay with their existing franchise retailer as a “default” customer. Default tariffs arose as a result of the deregulation of the NEM, and are set and regulated by IPART.

The exposure of franchise retailers, such as Integral Energy, to wholesale electricity prices in the NEM for default customers has thus far been effectively hedged by ETEF. However, prior to the 2007 Retail Determination, the NSW Government announced the phased elimination of ETEF, which partly accounts for the scale of the price increase allowed by IPART, which will subject Integral Energy to a larger exposure to pool price volatility as ETEF rolls-off.

Figure 1 demonstrates a hypothetical committed load Integral Energy would be required to hedge as the ETEF roll-off develops. Projections of ETEF loads are made with an assumed decrease rate of 11% as the default case, which is consistent with historical data. A low decrease rate of 6%, and a high decrease rate of 16%, are also considered.

**Figure 1. Default T3 Load Position for the Low, Medium and High Decrease cases.**



The existing hedging strategy used by Integral Energy has been very successful in immunising the business against pool price volatility arising from contract customers. Part of this success is related to timing features inherent in customer contracts. For example, Integral Energy can choose when to commence retail campaigns, and the

duration of contracts are deterministic. In contrast, default load is assigned to franchise retailers by government legislation, and the duration is potentially indefinite. These features make the task of hedging default load more complex, requiring the consideration of alternative hedging strategies.

## Desired Outcomes

The aim of this project is to explore approaches to obtaining "optimal" hedging strategies for controlling the risk the retailer is exposed to using a given set of derivative contracts. The committed load exposure facing Integral Energy from the ETEF roll-off will be the sample hedging problem under consideration.

Some of the issues involved may include:

1. Choice of objective function for the optimisation:
  - a. Value at Risk;
  - b. Earnings at Risk;
  - c. Profit at Risk.
2. An appropriate and/or tractable definition of "optimal" must be established. Typically, stochastic optimisation problems involve one of the following:
  - a. maximising return for a given level of risk;
  - b. minimising risk for a given level of return; or
  - c. maximising the expected utility of a strategy.
3. Specification of the model for the price/demand process:
  - a. Continuous time model;
  - b. Discrete time model.
4. The appropriate class of derivative contracts must be identified for establishing the hedge. Available classes include:
  - a. Energy derivatives (e.g. swaps, caps, futures);
  - b. Weather derivatives.

This is a fairly open ended problem. Data is available to back-test any models that might be implemented.