Price discovery in the New Zealand wholesale electricity market under 100% renewable electricity supply

Discussion with the Electricity Authority

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Friday, 23 July, 2021

Understanding

Background

- MDAG is undertaking a project to describe how price discovery would work in the New Zealand wholesale electricity market (including both spot and hedge) under a 100% renewable electricity system

Objective

- The project's objective is to develop sound recommendations on whether (and what) changes should be made to the wholesale electricity market assuming 100% renewable supply to ensure economically efficient price signals (from short to long term) to meet the statutory objective of promoting competition in, reliable supply by, and the efficient operation of the electricity industry for the long-term benefit of consumers

Agenda

1. Problem definition

a) An outline of the consultant's understanding of the problem – price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

b) An outline of the consultant's experience in dealing with the issue, and understanding of the approaches other relevant jurisdictions are exploring and have taken to the issue

c) An outline of the consultant's understanding of the challenges for New Zealand in dealing with this issue

3. Option identification and analysis

a) The approach the consultant would propose for identifying options and for selecting the preferred option

Problem Definition

Understanding of the problem: price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

- Traditional electricity market design didn't anticipate the renewables revolution. Either
  - economic – wind and solar are now the lowest cost new entrants, or
  - government intervention in the name of clean energy on the scale that has been seen
- For example, renewables auctions conducted outside of the traditional market arrangements are now the primary route to market for any new generation investment in a number of jurisdictions
- The issue varies widely by geography. Some countries are further down the renewable path than others

Problem Definition

Understanding of the problem: price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

- New Zealand
  - one of the highest renewable penetration levels in the world
  - penetration is growing further organically
  - a unique situation where much of its renewables are currently hydro
  - the Government is considering a significant intervention intended to facilitate 100% renewable electricity as part of a wider policy to reduce national GHG emissions
- Collectively this means that
  - intra-year prices less volatile than a similarly high renewable country with no hydro
  - price formation from an increasingly small non-renewable “wedge”
  - at some stage, a tipping point regarding price formation will be reached

Problem Definition

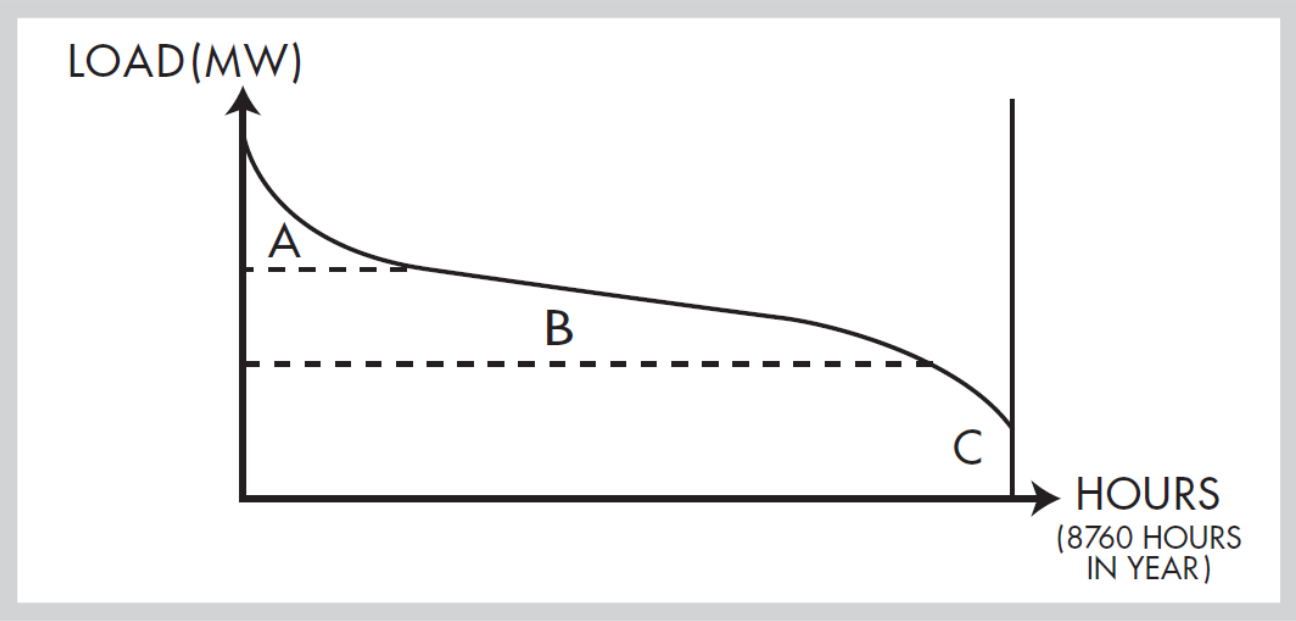
Understanding of the problem: price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

- Internationally, a new transition is underway and at stake are some of the essential functions currently performed by electricity markets
- There is particular uncertainty regarding the most fundamental task of all markets: ensuring an efficient allocation of resources
- Electricity markets have been developed since the 1990s and now are taken for granted in many jurisdictions. But before long, without significant reform, they might simply cease to perform what was possibly the main reason for their creation: to efficiently attract and support new generation investment

Problem Definition

Historical perspective: the optimal capacity mix under central planning

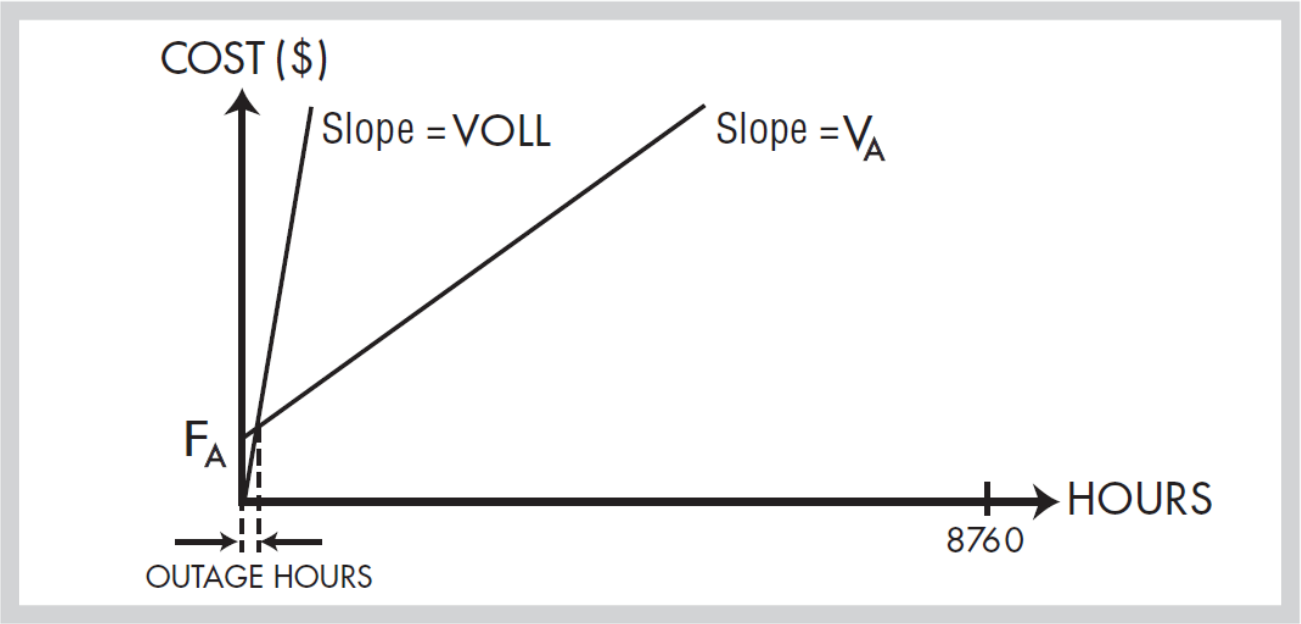
FIGURE E.1 Load duration curve.



Taken from: *The Importance of an Active Demand Side*, Hamish Fraser, Electricity Journal, Nov 2001, and adapted for the Edison Electric Institute book *Making Competition Work in Electricity*, Sally Hunt, published by Wiley Finance, New York 2002

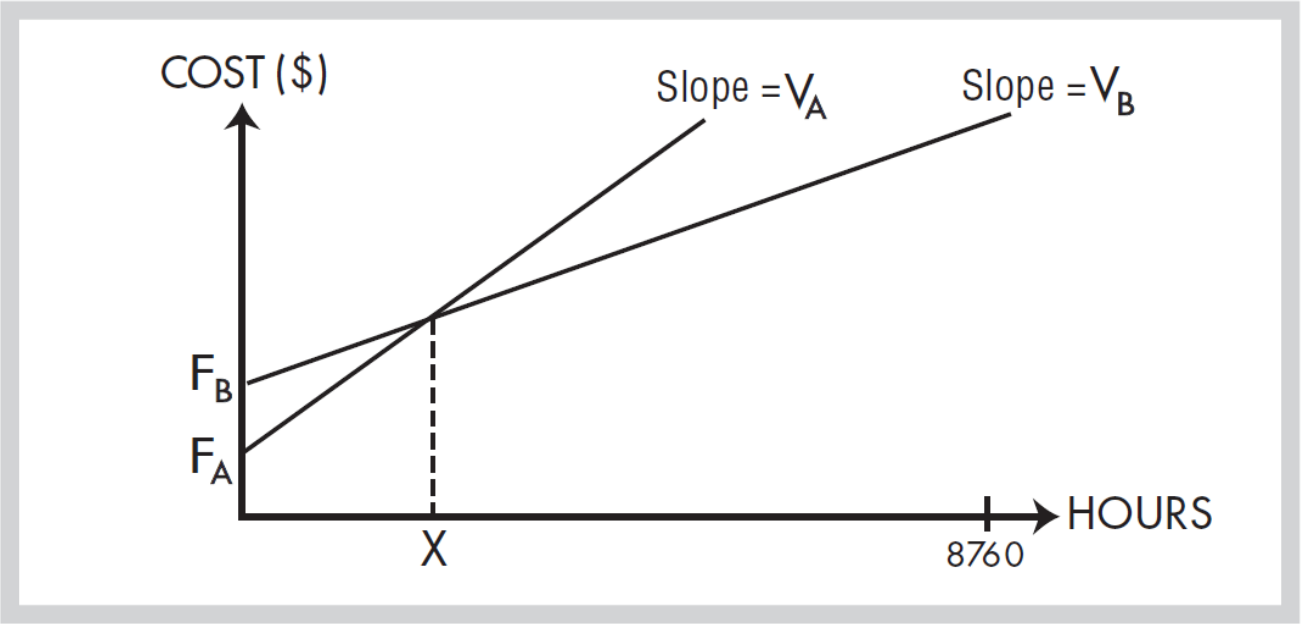
Problem Definition

FIGURE E.2 Economic outage hours to allow.



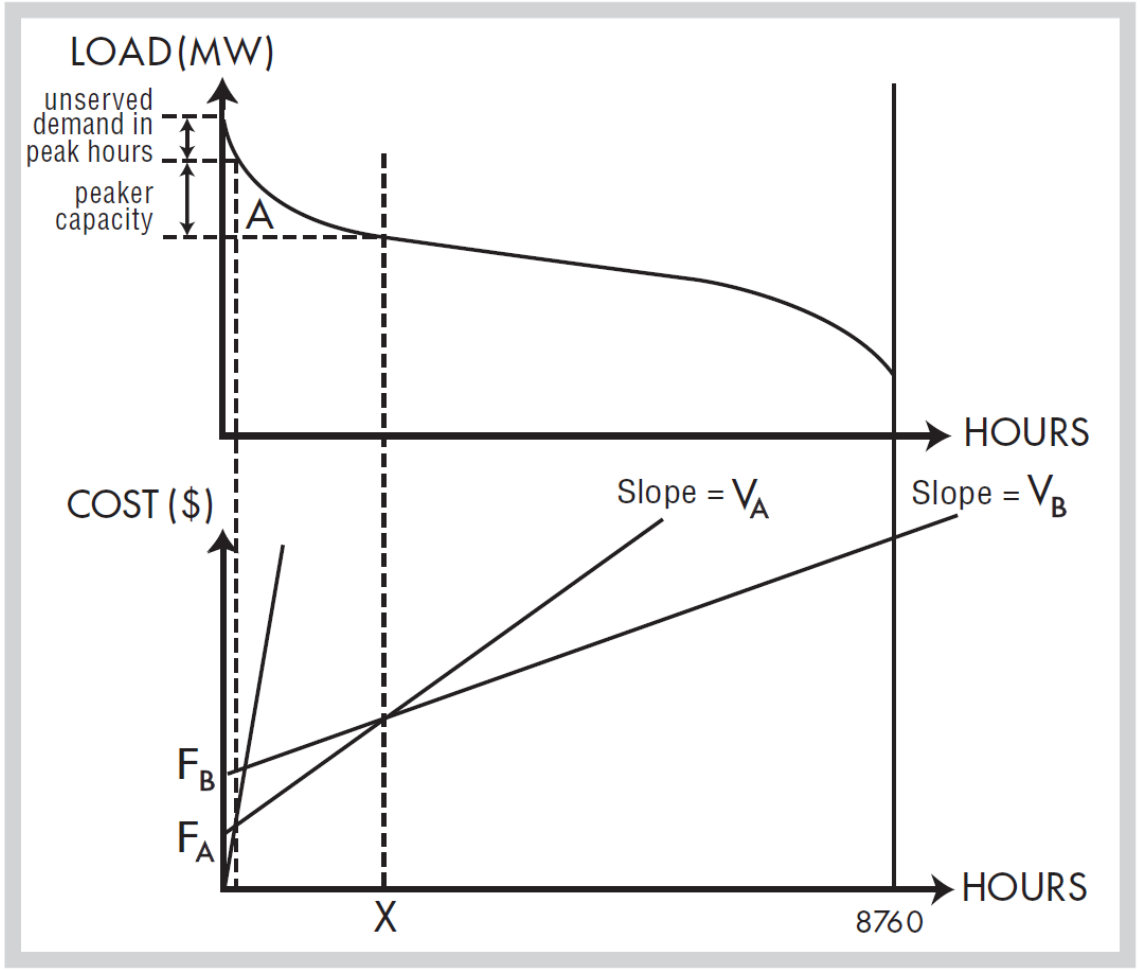
Problem Definition

FIGURE E.3 Run-time of last peaker built.



Problem Definition

FIGURE E.4 Calculation of required peaking capacity.



Problem Definition

FIGURE E.5 Calculation of required mid-load capacity.

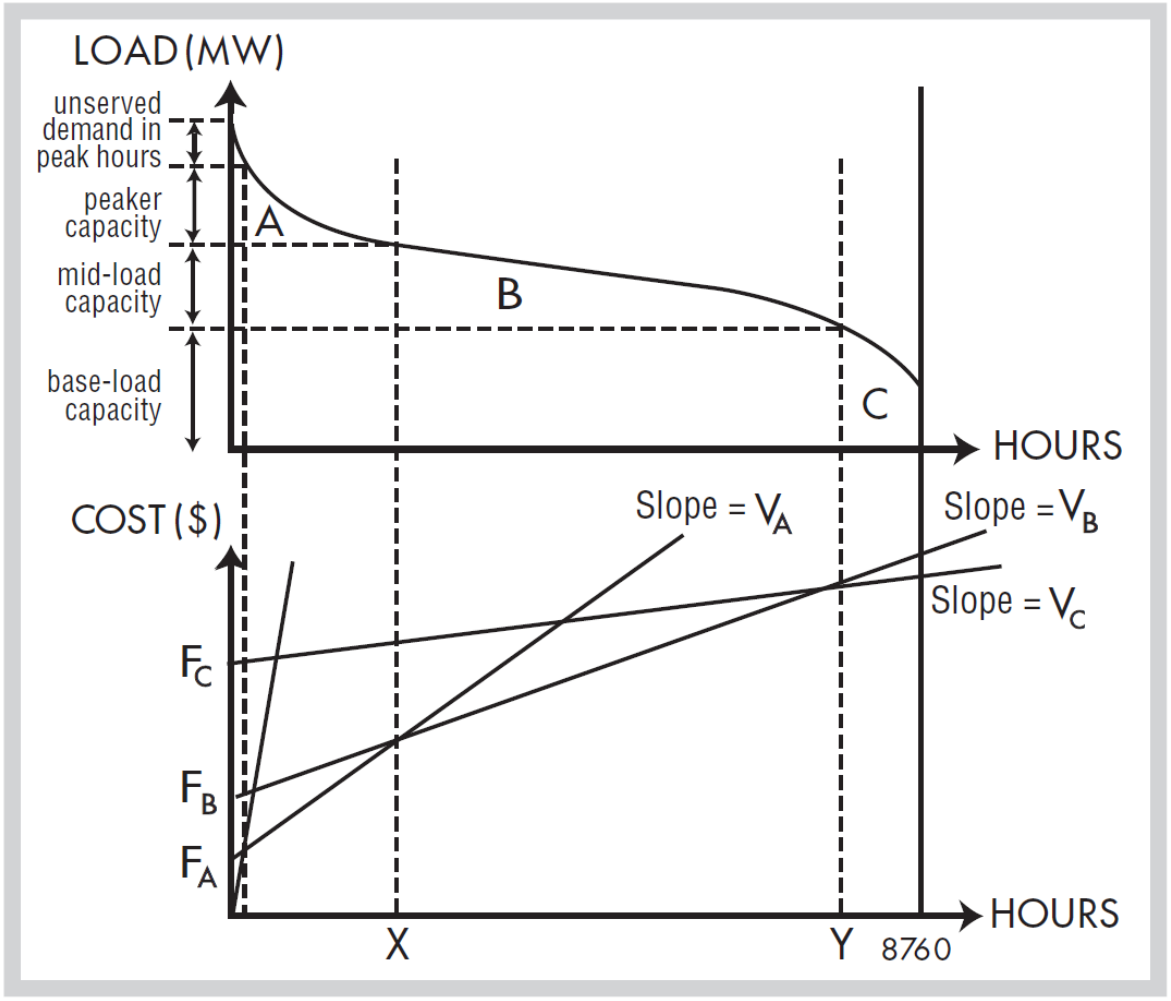
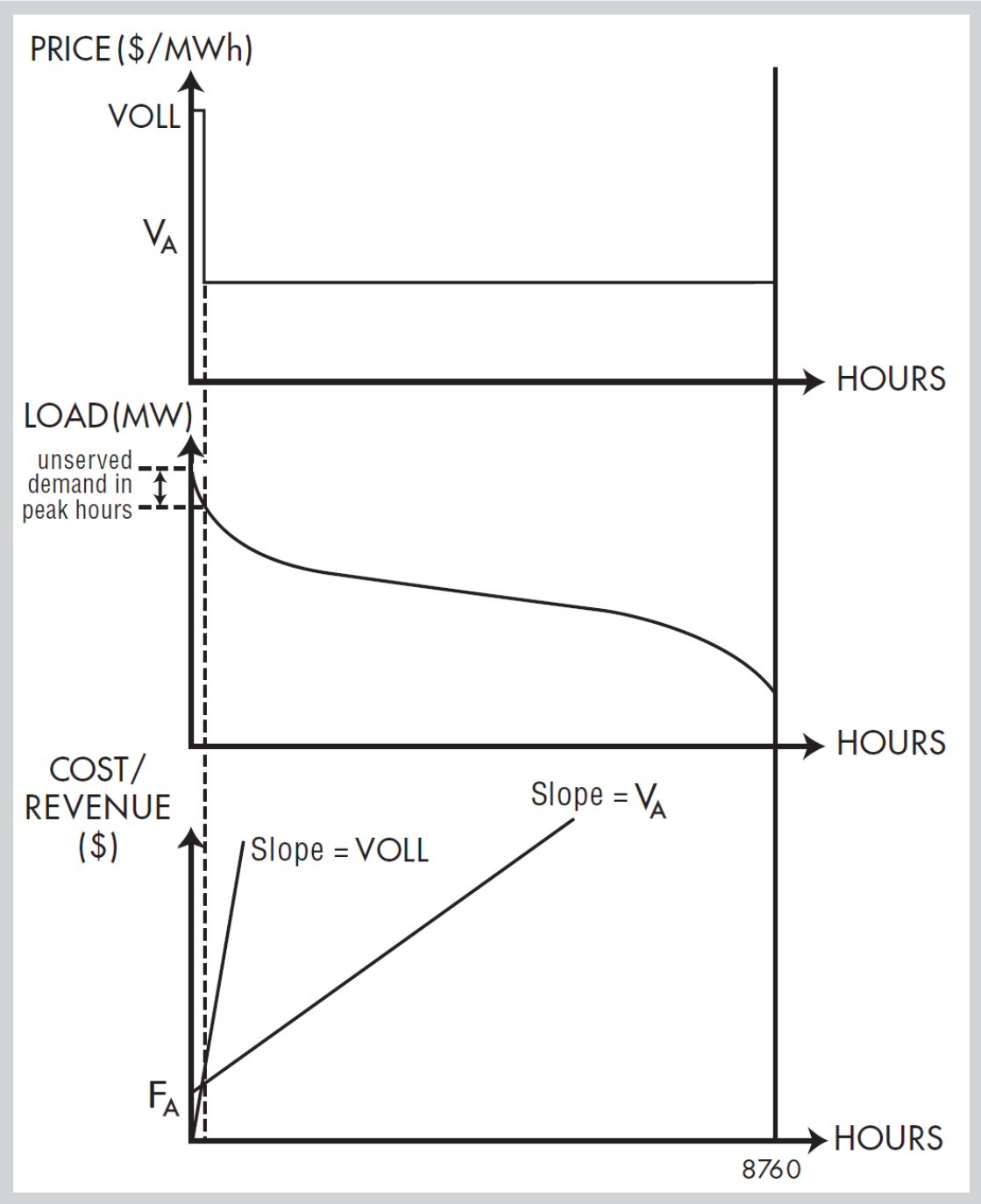


FIGURE E.6 Evaluation of how many hours of outage will result.



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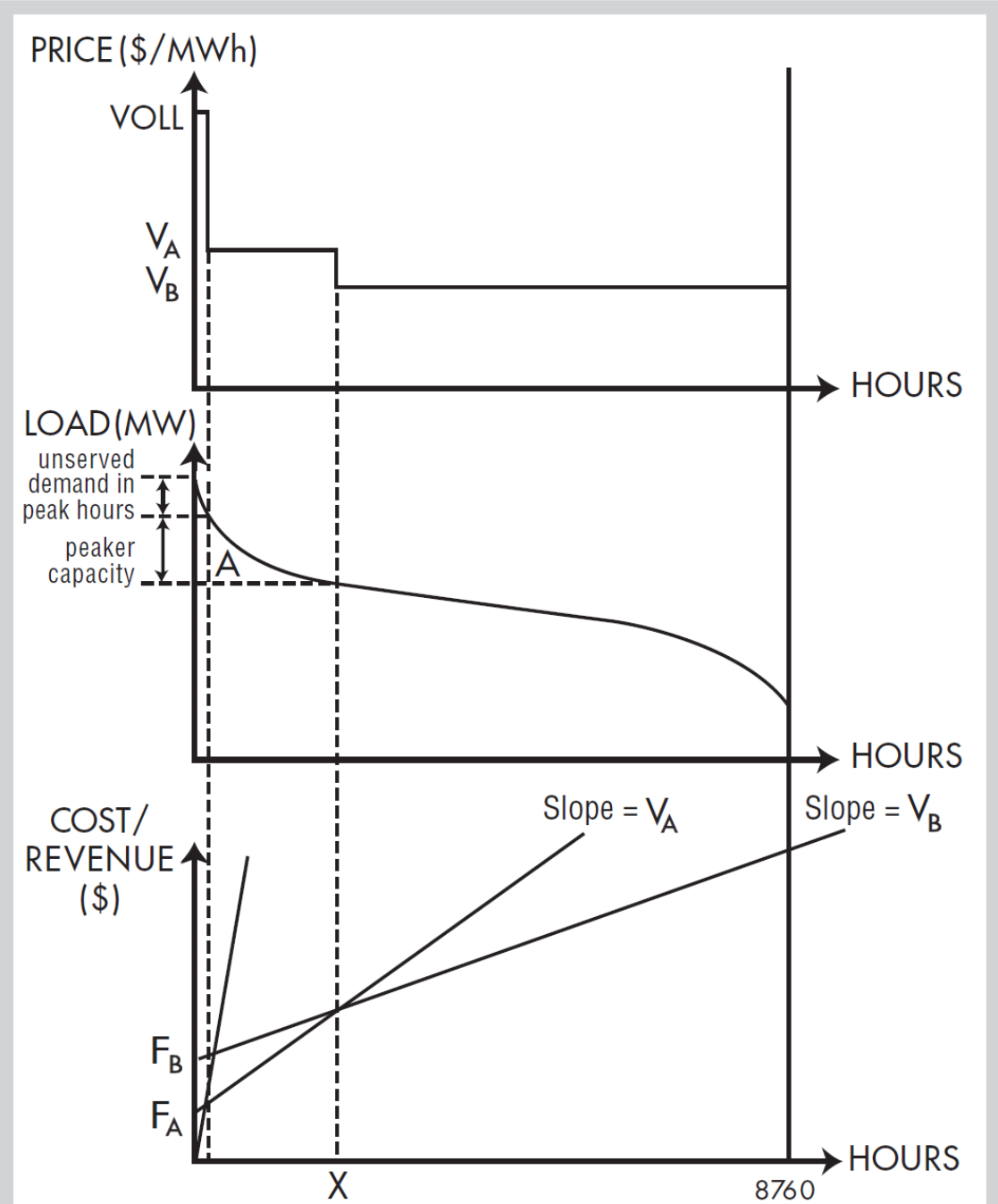
Problem Definition

Historical perspective: the optimal price signals in competitive wholesale electricity markets

FIGURE E.7 Evaluation of how much peaking capacity will be built.



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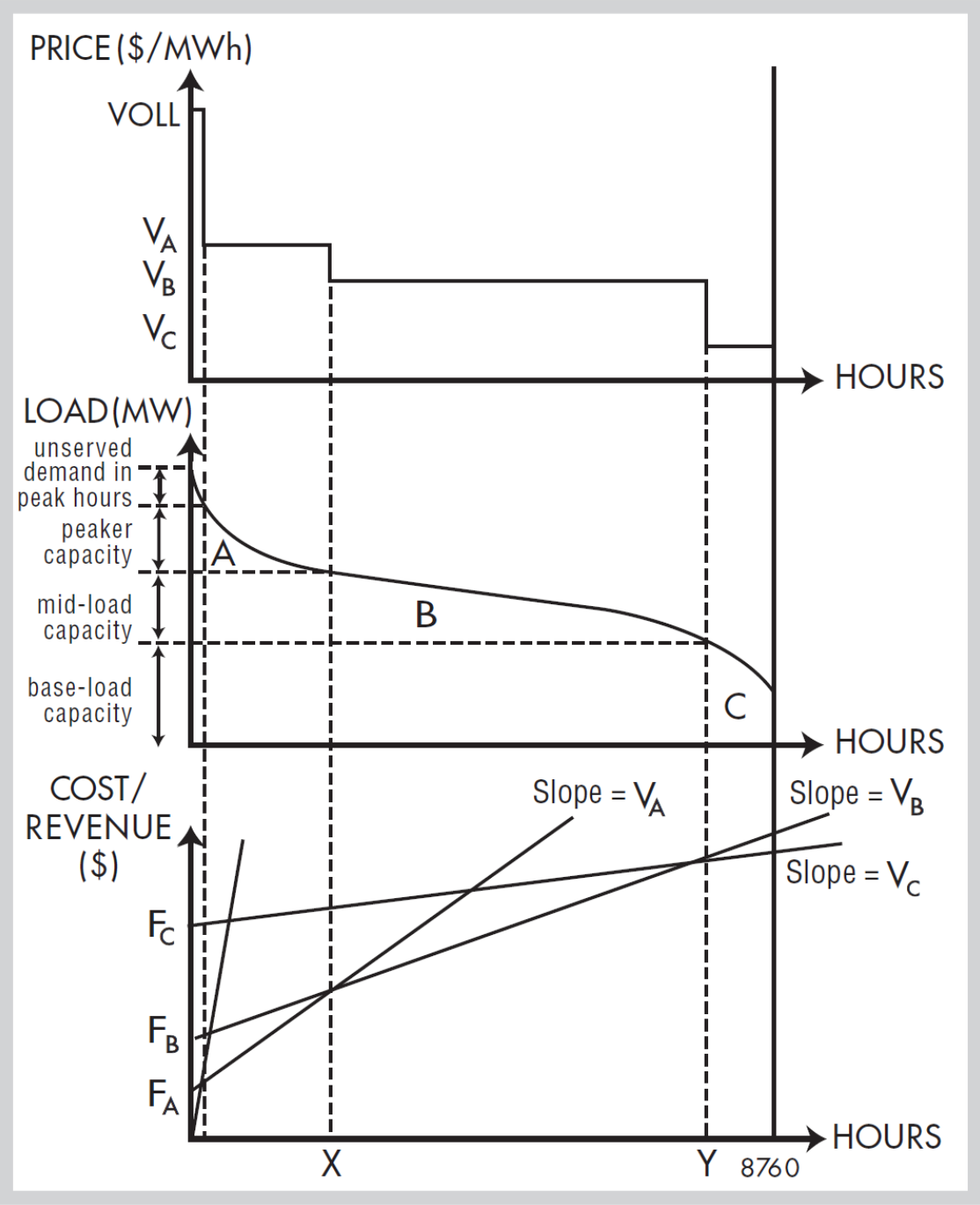
Problem Definition

Historical perspective: the optimal price signals in competitive wholesale electricity markets

FIGURE E.8 Evaluation of how much mid-load capacity will be built.



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- But if the economically-dominant technology has zero variable cost, the competitive price will alternate between zero and VOLL
- This price outcome is also to be expected (but not to be remunerative) if this technology is forced in on a non-economic basis
- Also to be expected if the system is energy-constrained rather than capacity-constrained
- Doesn't mean that there wouldn't still be a mix of renewable technologies since they are non-dispatchable

Problem Definition

Understanding of the problem: price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

- Spot price outcome could involve
  - long periods of energy price equal to zero (or less)
  - heavy reliance on capacity prices ("internet model") or, in an energy-constrained system, some sort of reservation/ scarcity payment
  - heavy reliance on payment arrangements for ancillary services
  - increased price volatility in one form or another, because remuneration of costs would be heavily dependant on achieving revenues during periods of system scarcity/ stress
- Would this be sustainable/ efficient/ reliable?: **not clear**
- Forward prices (hedges)?: historically there has not been a sustained and predictable wedge between forward and spot prices, for good reason

Problem Definition

Understanding of the problem: price discovery under 100% renewable electricity supply in the New Zealand wholesale electricity market

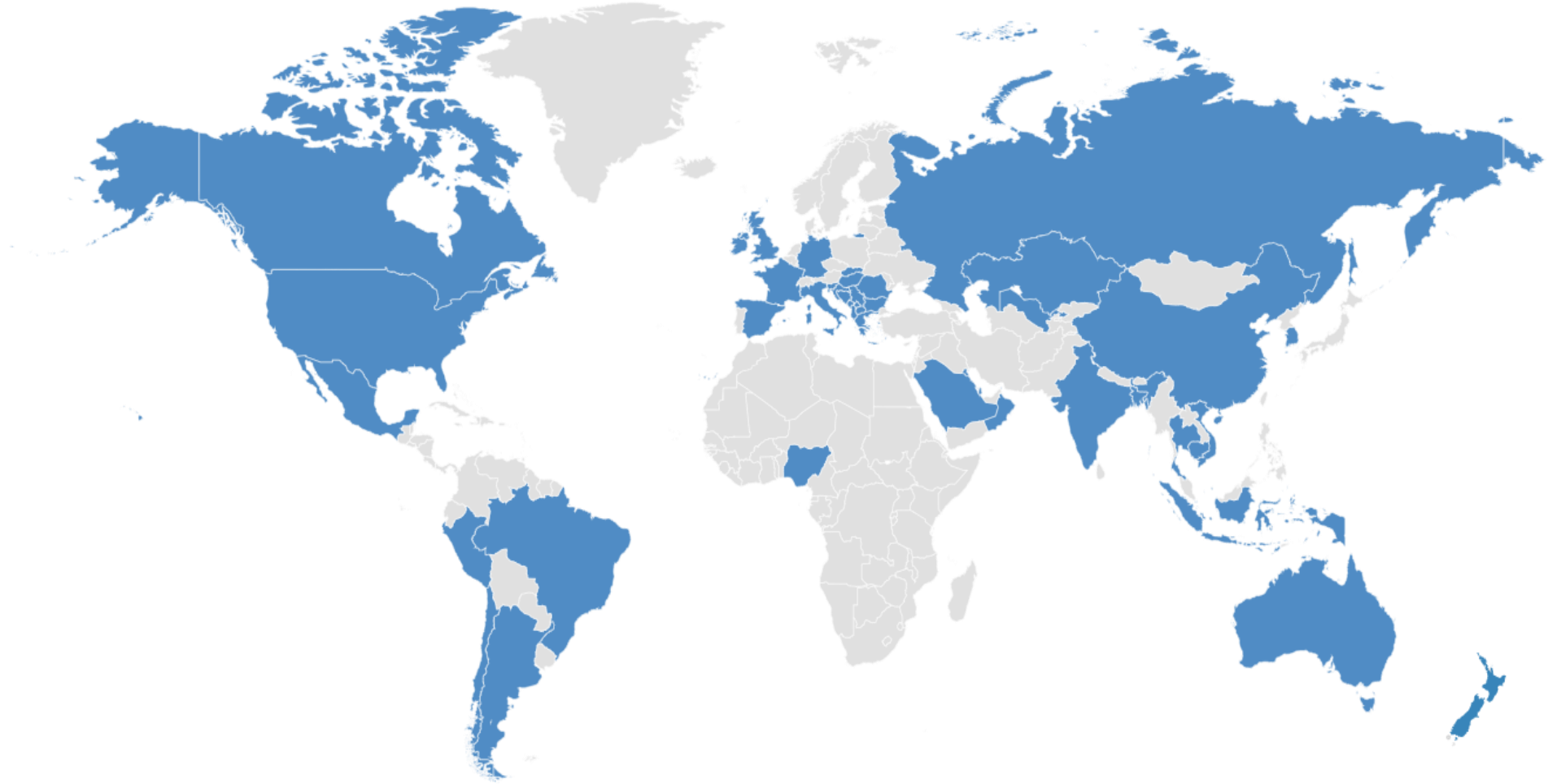
- What if 100% renewable is achieved by “force”, rather than by the market itself
  - similar energy, (capacity) and ancillary services price consequences could be expected
  - likewise in the forwards (hedge) markets
  - but, less likely that the resultant prices could be remunerative to market participants if the marginal entrant did not enter on the basis of a market return expectation
- Would this be sustainable/ efficient/ reliable?: **difficult to see the conditions under which it could be**

Problem Definition

Experience dealing with the issue and understanding of approaches other relevant jurisdictions are exploring and have taken to the issue

- Some European countries are dealing with low prices and challenging market investment signals due to the increasing penetration of renewables
- The issue is currently much less “on the radar” in North America and other major areas in which electricity markets exist
- However probably no country other than New Zealand is in the position where 100% renewables is not only aspirational, but also potentially achievable (if sensible to do so) within such a short period of time
- Nevertheless the issue, generally, is the Next Big Thing in electricity market design, and energy policy-makers world-wide will be looking to this MDAG/EA study with great interest

Other Jurisdictions



Problem Definition

Understanding of the challenges for New Zealand in dealing with this issue

- Lead the world
- Determine if a traditional spot market arrangement remains feasible, or alternatively whether some form of revised market design, centralised long-term contract market, or other arrangement, might be appropriate
- Consider the consistency of Govt intervention and a functional market
- Making sure that whatever arrangements are chosen can continue to allocate resources efficiently and serve load reliably
  - short-term: production efficiency, including efficient rationing of water
  - long-term: efficiently attract and support new generation investment

Option Identification and Analysis

Approach for identifying options and for selecting the preferred option

1. Define problem
2. ***Establish criteria against which alternative solutions are measured***
3. ***Develop alternative solutions***
4. Evaluate those options against the criteria established and select the best option accordingly

Option Identification and Analysis

Identifying options

- International best practices (little guidance)
- Place system security as the No. 1 objective, followed by efficiency
- Consider the status quo and variants on the status quo, for example with a capacity or other scarcity-type product
- Don’t shy from potentially transformative options, which may be necessary, in the context of the 4 recognised models of industry structure
- Treat the possibility of Govt intervention as a defining attribute of the option – the best solution in a world where Govt intervention is contemplated might not be the best in one where it is ruled out, so options may need to be defined accordingly

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