Disclaimer

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Furthermore, while all reasonable care has been taken in compiling this presentation, Meridian cannot guarantee it is free from errors.
Reservoir management: uncertainties, risks, and rewards

- Sources of uncertainty
- The role of hydro in New Zealand
- Reservoir management concepts
- Portfolio management
- Maximising value through asset management, hydrology, wholesale market
About Meridian

- Integrated renewable generator and retailer
  - New Zealand’s largest electricity generator
  - 272k* customers – Meridian Retail (239k) and Powershop (33k)
- International wind and solar generation facilities
- Strong portfolio of future generation options in New Zealand and internationally
- Innovating in new products and services

* As measured by ICP’s
Hydrology: one of many sources of uncertainty Meridian manages

Source: Meridian
Hydro generation is the cornerstone of NZ’s electricity supply ...
...and underpins NZ’s flexible electricity system

Hydro’s lowest average output exceeds thermal’s highest average output

Source: Centralised Dataset, Meridian
Meridian’s portfolio

- Manapouri
  - 800MW / ~5,100 GWh p.a.
  - Storage 440 GWh

- Waitaki scheme
  - 1,538MW / ~7,000 GWh p.a
  - Storage ~1,700 GWh (Pukaki)

- Wind
  - NI: 298MW / ~1,150 GWh p.a.
  - SI: 58MW / ~190 GWh p.a.
New Zealand hydrology: sum of many moving parts

Source: Meridian. Note: Tekapo and Pukaki inflows reflect energy generated from all Genesis and Meridian stations in the Waitaki scheme.
Average weekly inflows anti-correlated between islands within the year…

- Inflows dominated by rainfall and snow
- NI inflows driven by winter/spring rainfall
- SI profile driven by snowmelt over summer
- However, anti-correlation effect is limited

**Graphs:**
- **North Island Inflows (average, weekly)**
- **South Island Inflows (average, weekly)**

*Source: Meridian*
... and inflows vary markedly across weeks & seasons ...

Source: Meridian
...while inflows are anti-correlated with demand
Limited long run trend information is available from historical information

- Science of weather prediction inexact (expected vs forecast)
- Long-term cycles observable after the fact
- While we do model snowpack and gain some insight from snow storage...
- ...historic distributions best indicator of future variability

Source: Meridian
All this volatility reflected in wholesale prices

This price volatility impacts all market participants

![Graph showing GWh Storage (NZ hydro) and $/MWh over time from Jan 01 to Jan 11)](image)

Source: Meridian
Inflows can be stored, but capacity varies

Storage and average annual inflows (GWh)

- Manapouri
- Pukaki
- Taupo & Waikato
- Hawea & Clutha
- Tongariro
- Waikaremoana
- Tekapo
- TrustPower SI Hydro

Source: Meridian
Thermal fuel storage is material

Source: Meridian. Thermal fuel storage reflects estimates of both physical storage capability and plant efficiency.
Reservoir management

- Reservoir management
  - Choice of weekly release of water
  - Balancing value of production for week against potential value if stored for release in later weeks

- Impacted by
  - Demand
  - Offered cost of thermal fuels now but more importantly in the future
  - NZ wide energy storage (both hydro and thermal) for that time of year

Economic cost

- Efficient storage management

- Lower storage
  - Water values increase due to excess peaking thermal operation (and shortage) whenever low inflows occur
  - Low production, high prices, high risk
  - Regulatory risk and loss of flexibility

- Higher storage
  - Costs increase due to excess spill requiring greater use of baseload thermal plant
  - Missed revenue opportunities due to spill, reduced production for same reason
  - Regulatory risk and loss of flexibility
Meridian Earnings Risks: S-curves

- Portfolio planning process manages the evolving S-curve
  - Committed sales and optimal position combined with simulated price/quantity outcomes indicate direction for trading
- Variability in revenue assessed for each quarter over next 3-5 years (updated weekly)
- Meridian’s lower revenue outcomes can be driven by low and high inflows

S-curve of Net Energy Revenue

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Probability Distribution
p(0)  p(1)

Limits

Low revenue outcome  VAR  Mean Net Energy Revenue  High Revenue Outcome

“The tail”: outcomes worse than the limits are possible
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Portfolio Optimisation: Bowtie Indicators

- “Bow tie” a key metric for assessing future revenue risk and contract position
  - Captures interaction of contract position and synthetic price distributions on net energy revenue distributions
- Calculated across multiple timeframes
  - Within-year variations due to load-shape, season and location factors

Illustrative Bow-Tie

- Net Energy Revenue ($)
- Mean
- Max
- P95
- P75
- P5
- P25
- min

- Minimum total spread
- Minimum P5-P95 spread

- Fewer contracts
- More contracts

Contract quantity as % of expected load

60% 110%
Meridian operates and executes a portfolio management process

- Clearly defined Governance from Board supported by policy and regular reporting
- Appropriate levels of balance sheet headroom, debt/funding facilities in place
- Consistent framework for measuring performance and revenue risks across different timescales and scenarios
- Assumptions scrutinised and updated routinely as market evolves and information revealed
- Extensive experience across all aspects of planning and execution phases
- No surprises approach
We operate a sophisticated modelling toolset

- Analytic tools/models used to explore and manage issues over multiple timeframes
  - Market simulation
  - Snowpack
  - Wind and weather forecasting
  - Demand forecasting
- Tools used to inform experts who ultimately decide and are accountable
- A variety of models used to simulate revenues
  - Modelling impacts of uncertainty in a range of future market conditions
  - Input assumptions reflect future market state via market offers, plant availability, inflow variability, demand and transmission
  - Outputs (water-values and releases) inform trading, reservoir operation and contract valuation
How good are the tools? Hindcasting provides a means to assess effectiveness

Pukaki & Tekapo Hydro Storage: Hindcasting versus Actual

Hyd Seq Beginning: 2000-2001

Source: Meridian
Price hindcasting shows similar results, even for extreme hydrology periods
Utilising water in real time is complex ... flexibility valuable

- Real-time operations consider physical constraints on storage and head ponds
  - Local transmission constraints, unit outages, market conditions
  - Environmental and resource constraints

- Uncontrolled or tributary flows vary across schemes and are material

- Strong links between operations and trading

Source: Meridian
We maintain our assets to sustain our ability to maximise revenue

- Reliable and flexible assets required for executing long and short-term strategies
- Individualised asset management strategies depending on the fit of each asset in the portfolio
- High performing assets
  - 0.18% hydro forced outage factor
- Recently completed GKS Hydro benchmarking analysis
  - 40 stations, 1,525 generating units with 100,000 MW of installed capacity
- Comparatively
  - Manapouri a leader
  - Waitaki in the upper quartile
- Cost performance
  - Sub $5/MWh cost in upper quartile, well below average of ~$20/MWh
- Continuous improvement opportunities remain and are built into regularly reviewed asset management plan
Summary

- Inflow variability is the dominant uncertainty faced by us and all market participants.
- We understand hydrology risk and manage it effectively.
- Our asset management capabilities are effective and support our hydrology management and wholesale trading activities.
- Reliable hydro plant, storage capability, and expert analytics give Meridian significant flexibility to maximise the value from the assets, particularly post Pole 3 commissioning.