Transmission Services

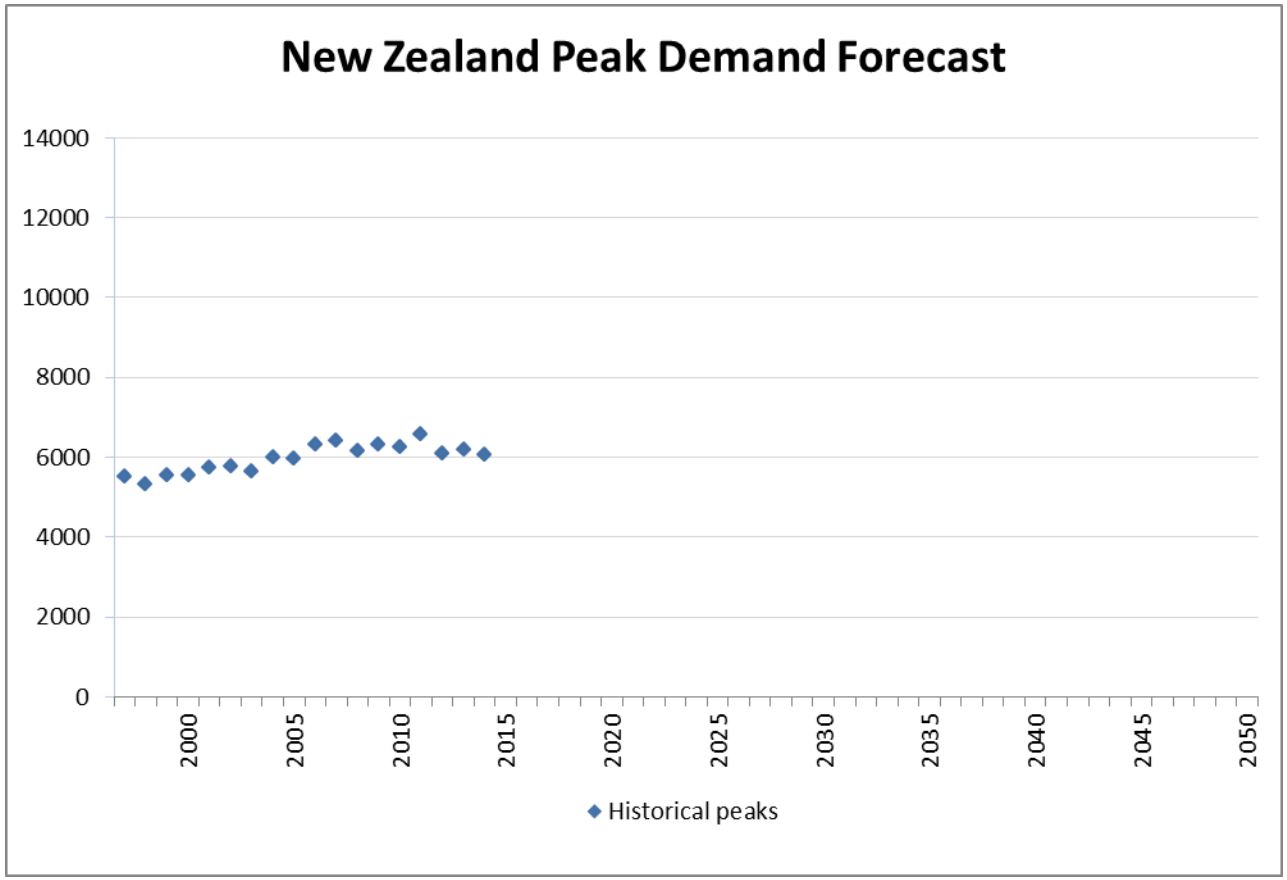
Looking at tomorrow’s need

TRANSPOWER

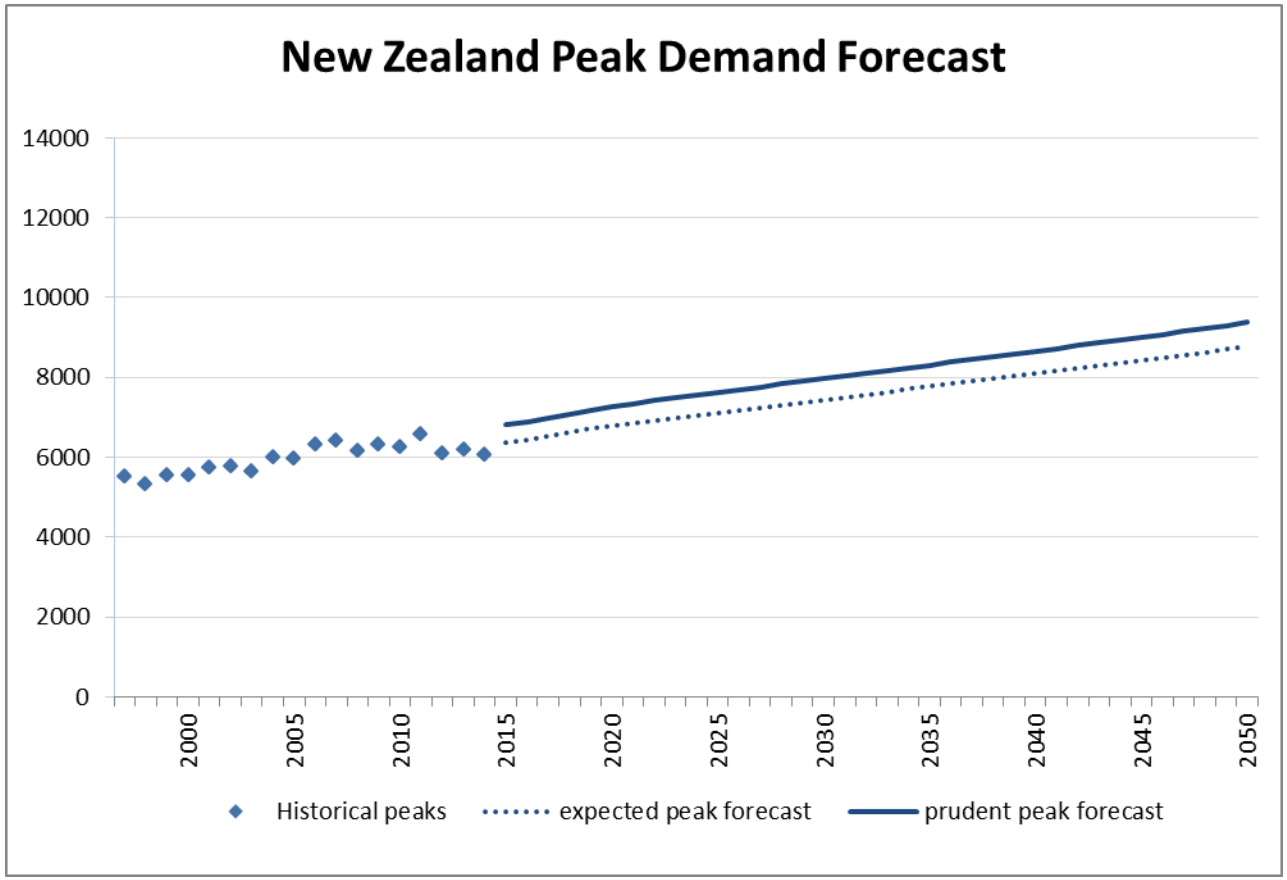
Introduction

- Presenting ongoing work updating Transpower's long-term view of the future grid
  - The future is uncertain
  - Transpower's assets
  - Our scenarios

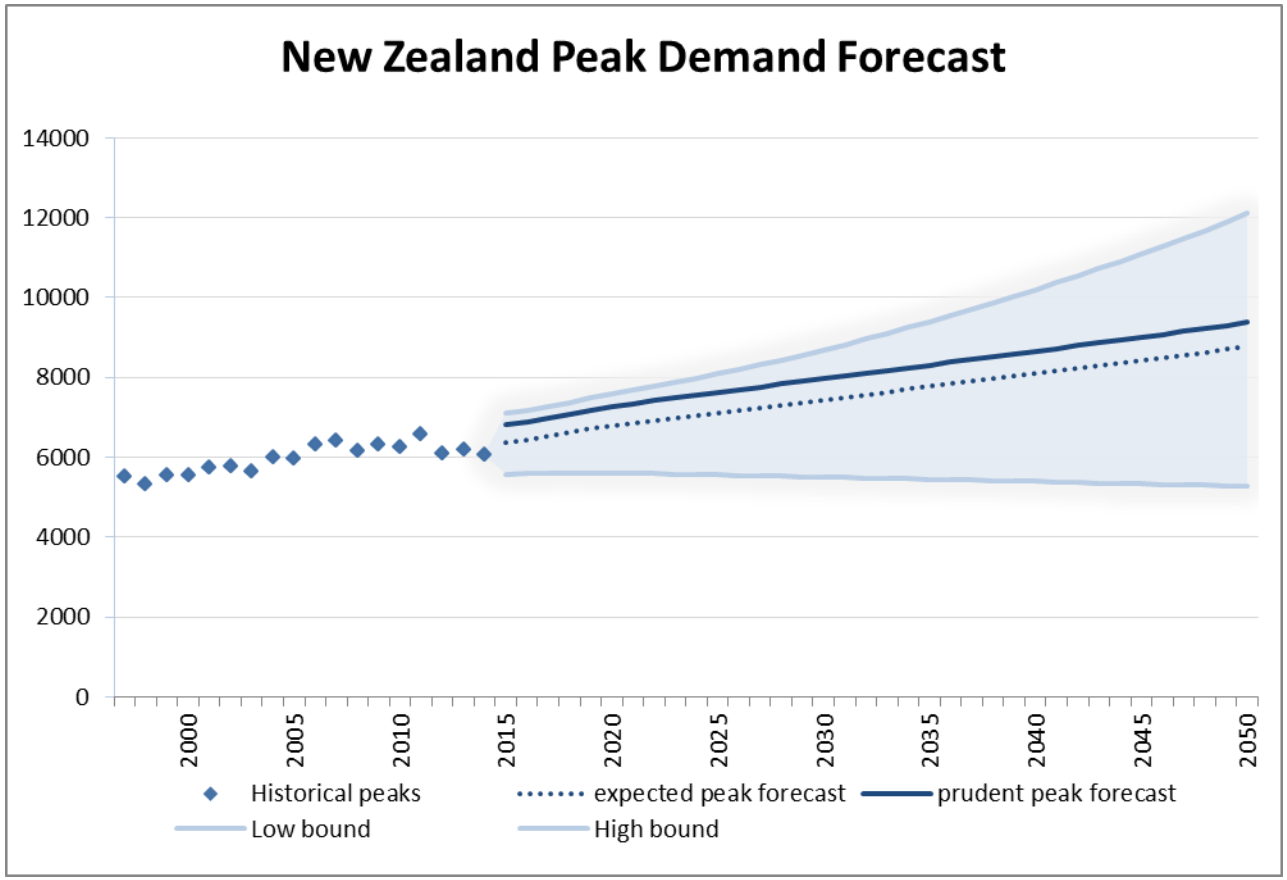
Demand uncertainty



Demand uncertainty



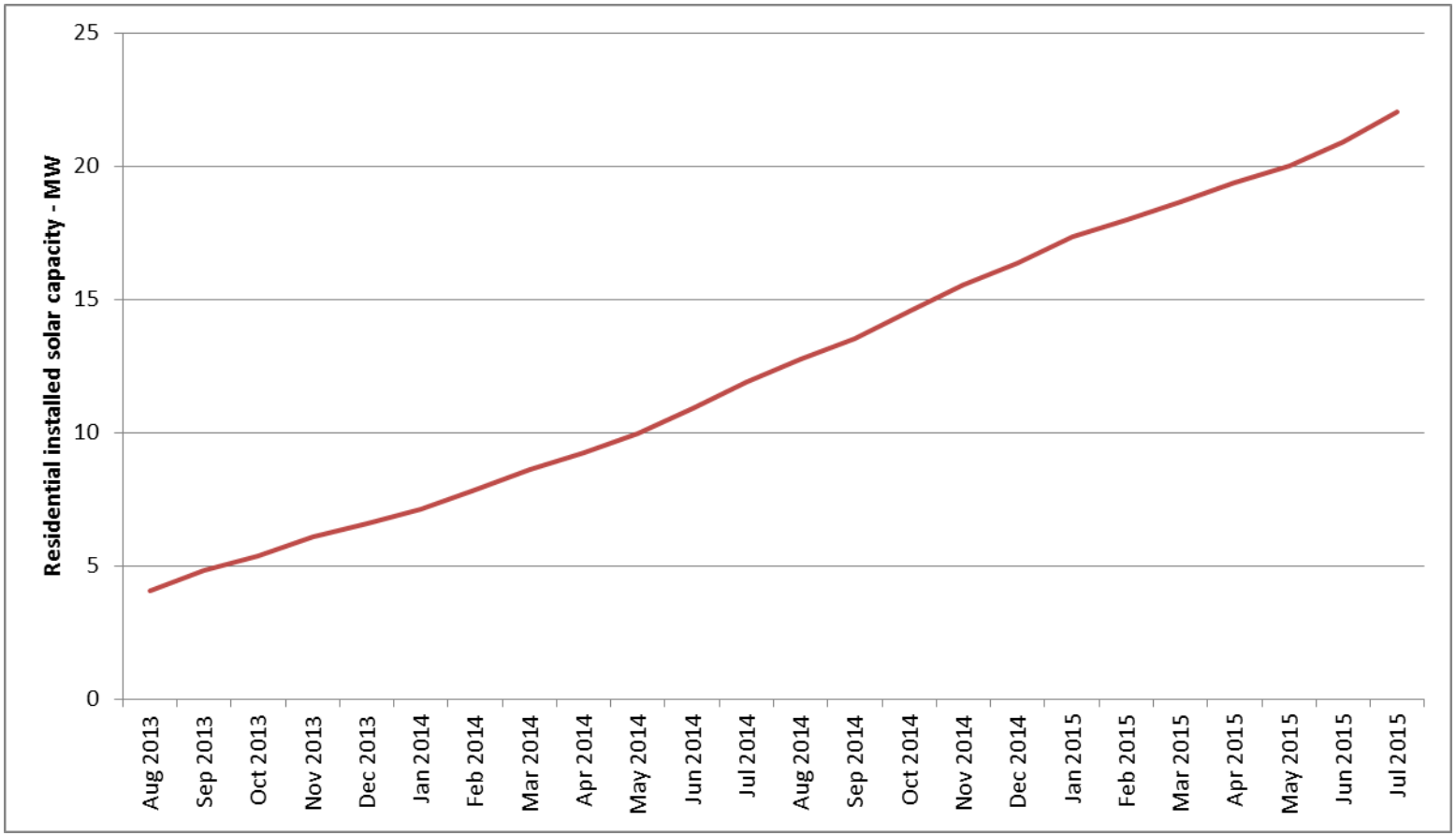
Demand uncertainty



Technology Uncertainty

- Residential solar PV uptake
- Energy storage
- Smart grids
- Electric vehicles

Residential solar

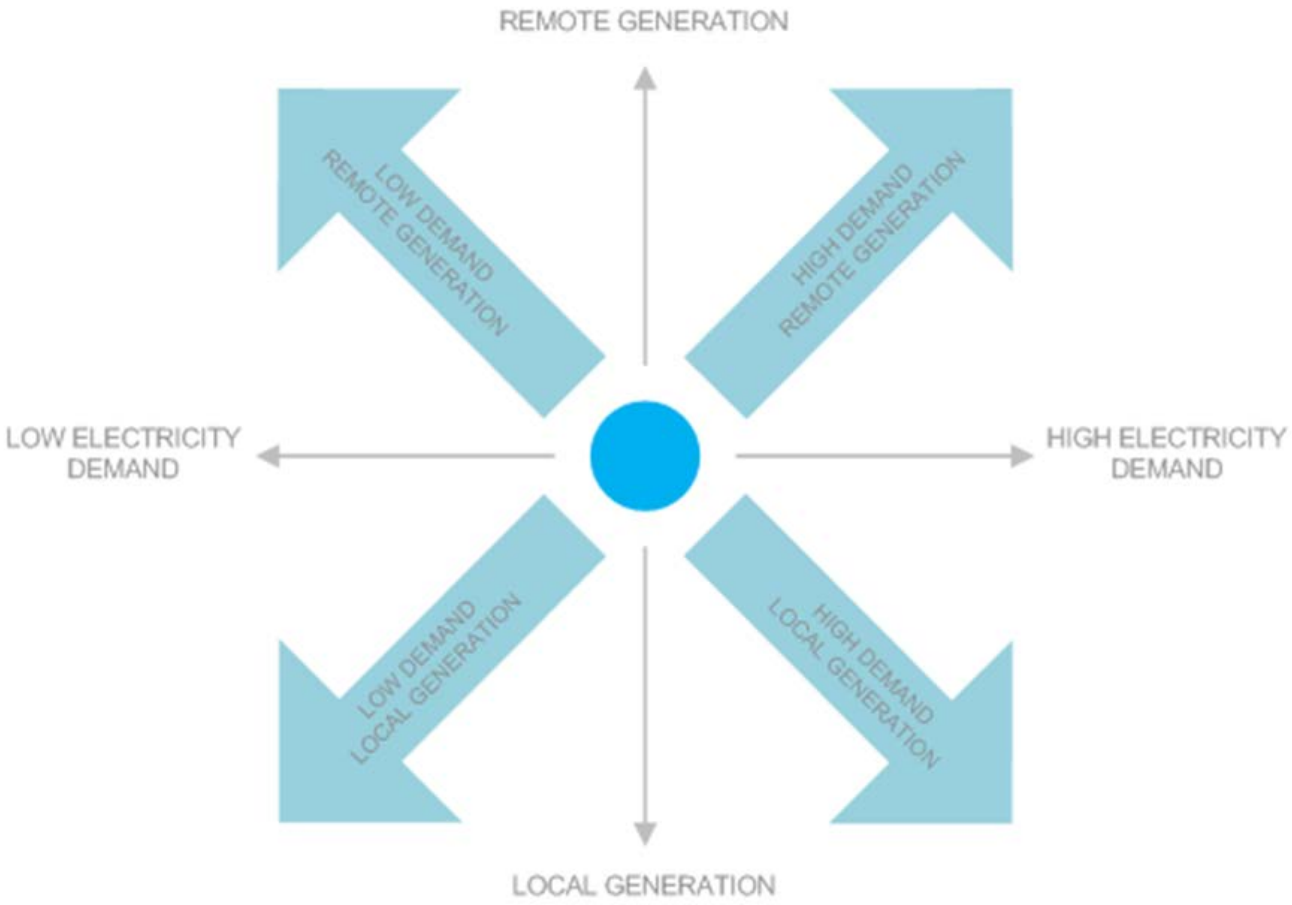


Transpower Assets

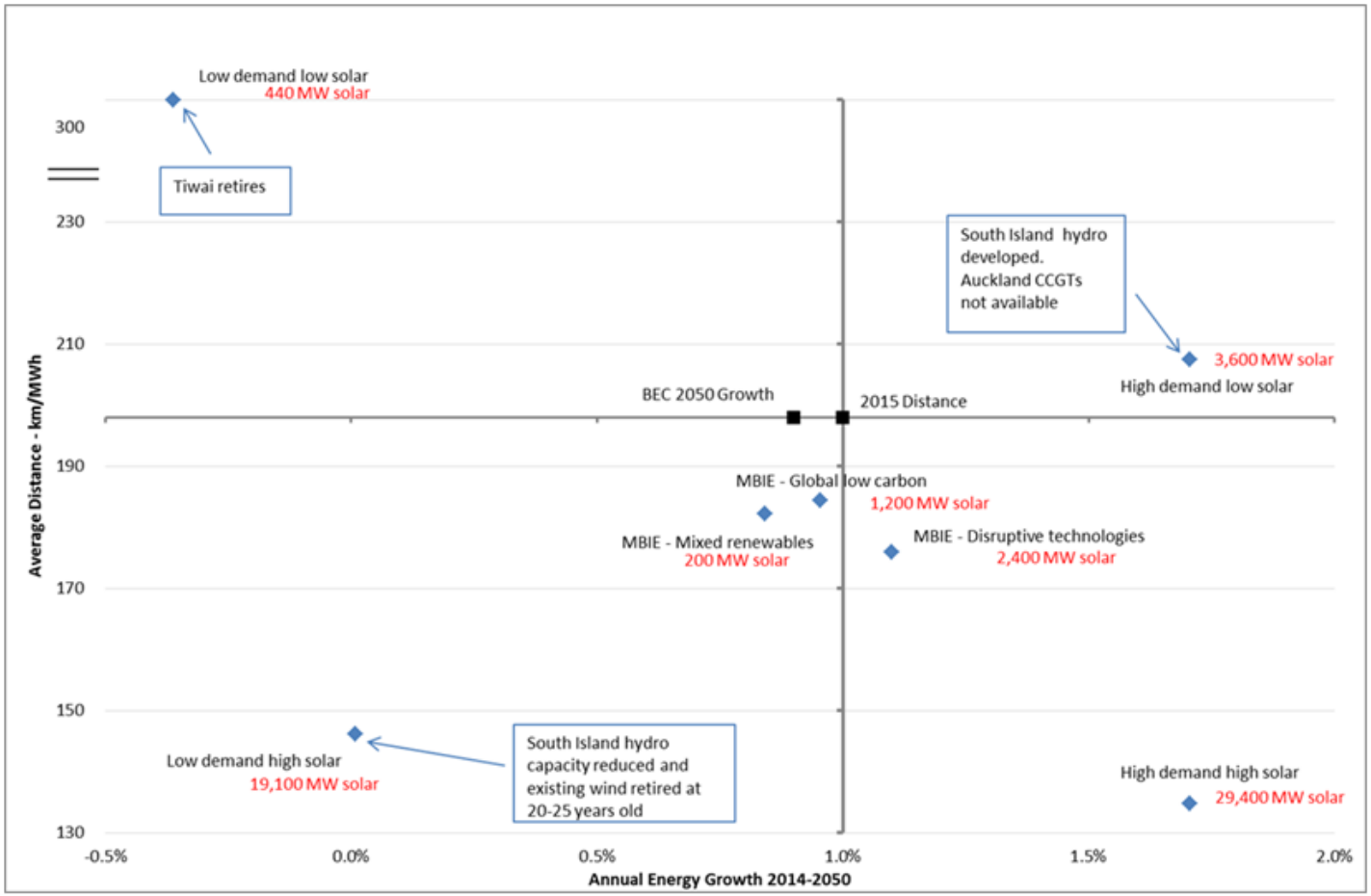
220/110 kV 250 MVA transformer
Cost: ~$8m
Life: 60 years

220 kV line
Cost: ~$2m/km
Life: 75-100 years

Our scenarios



Our scenarios in 2050



Our scenarios in 2050

Scenario label	Scenario name	Annual energy demand growth to 2050	Generation assumptions
LDLS	Low demand low solar	-0.4% Low EV uptake Tiwai closes from 2017	440 MW solar PV built
LDHS	Low demand high solar	0.0% Low EV uptake	19,100 MW solar PV built Some SI hydro closed Existing wind farms retired at 20-25 yrs
HDLS	High demand low solar	1.7% High EV uptake	3,600 MW solar PV built New SI hydro built Auckland gas plants closed
HDHS	High demand high solar	1.7% High EV uptake	29,400 MW solar PV built
MDMR	Medium demand mixed renewables	0.9% Low EV uptake	200 MW solar PV built
MDGLC	Medium demand global low carbon	1.0% Med EV uptake	1,200 MW solar PV built
MDDT	Medium demand disruptive technologies	1.1% High EV uptake	2,400 MW solar PV built

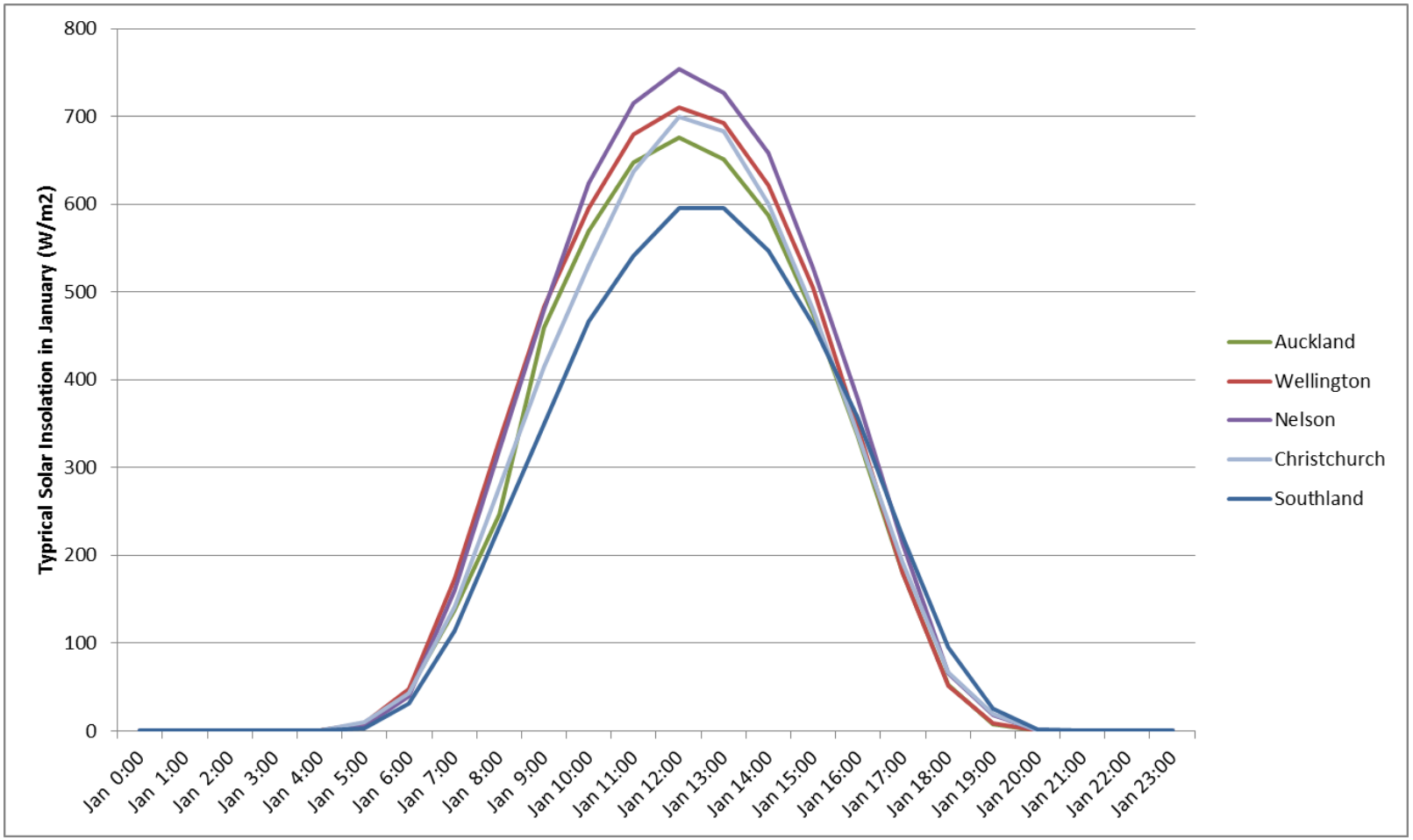
Modelling inter-regional flows

- Modelling undertaken in PLEXOS
- Hourly time-steps
- ‘Zonal’ (regional) resolution
- Transmission constraints removed to see what optimal dispatch would looks like
- Least-cost dispatch
- Three hydro scenarios
- Snapshots: 2015, 2020, 2035 and 2050

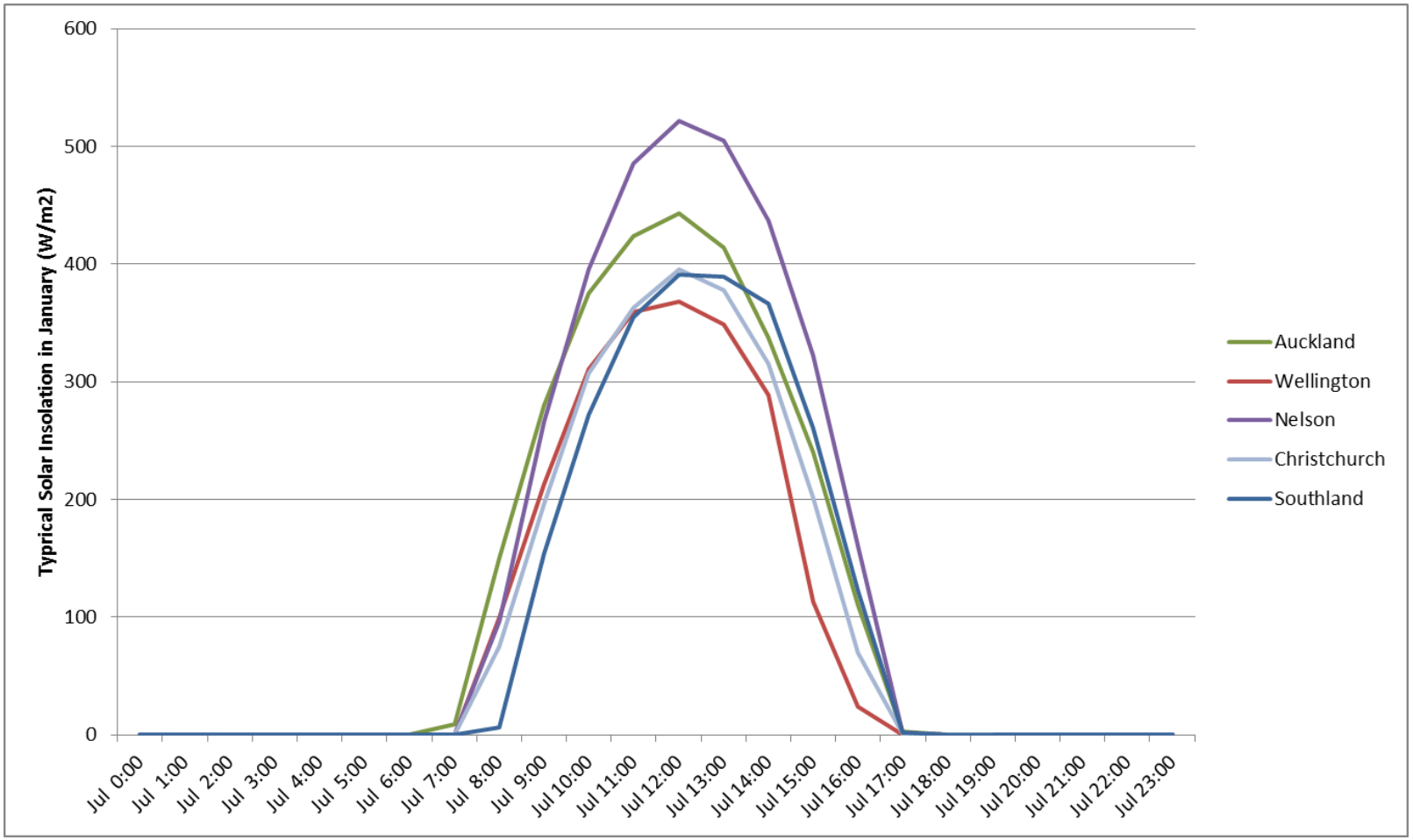
Modelling solar generation

- NIWA regional seasonal insolation data
- One large solar plant per region
- Limitations:
  - Energy balance only; power system stability not considered
  - Regional model means energy can be exchanged between PV installation within a region

Summer solar profiles



Winter solar profiles



Battery Storage

- Charge/discharge profiles modelled within PLEXOS
- Objective to minimise dispatch cost
- One big battery per region

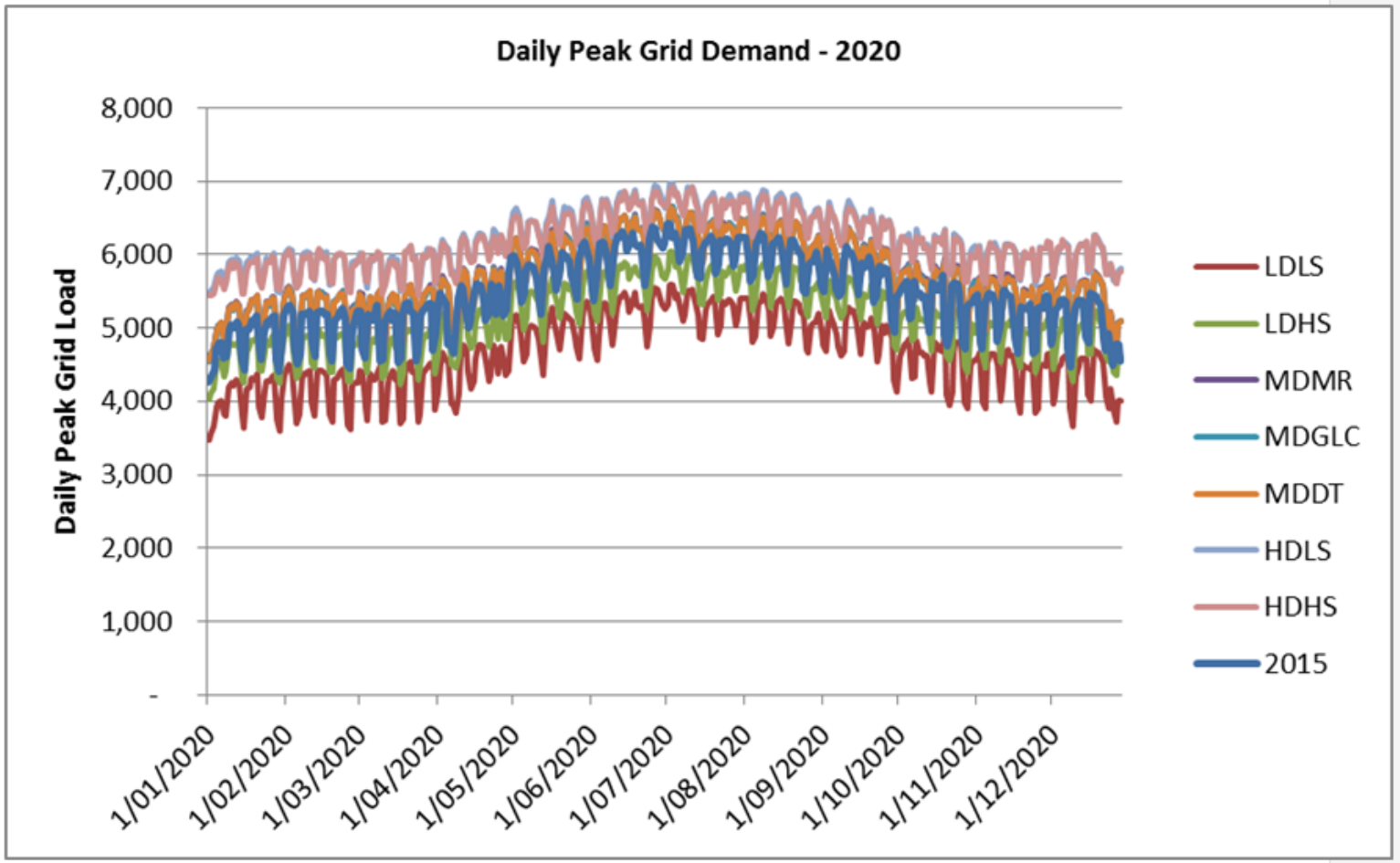
Losses

- Scenarios with large battery storage required us to model losses
- Otherwise the model would often transport massive amounts of energy to charge Auckland's batteries.
- Result was batteries increasing peaks rather than smoothing them

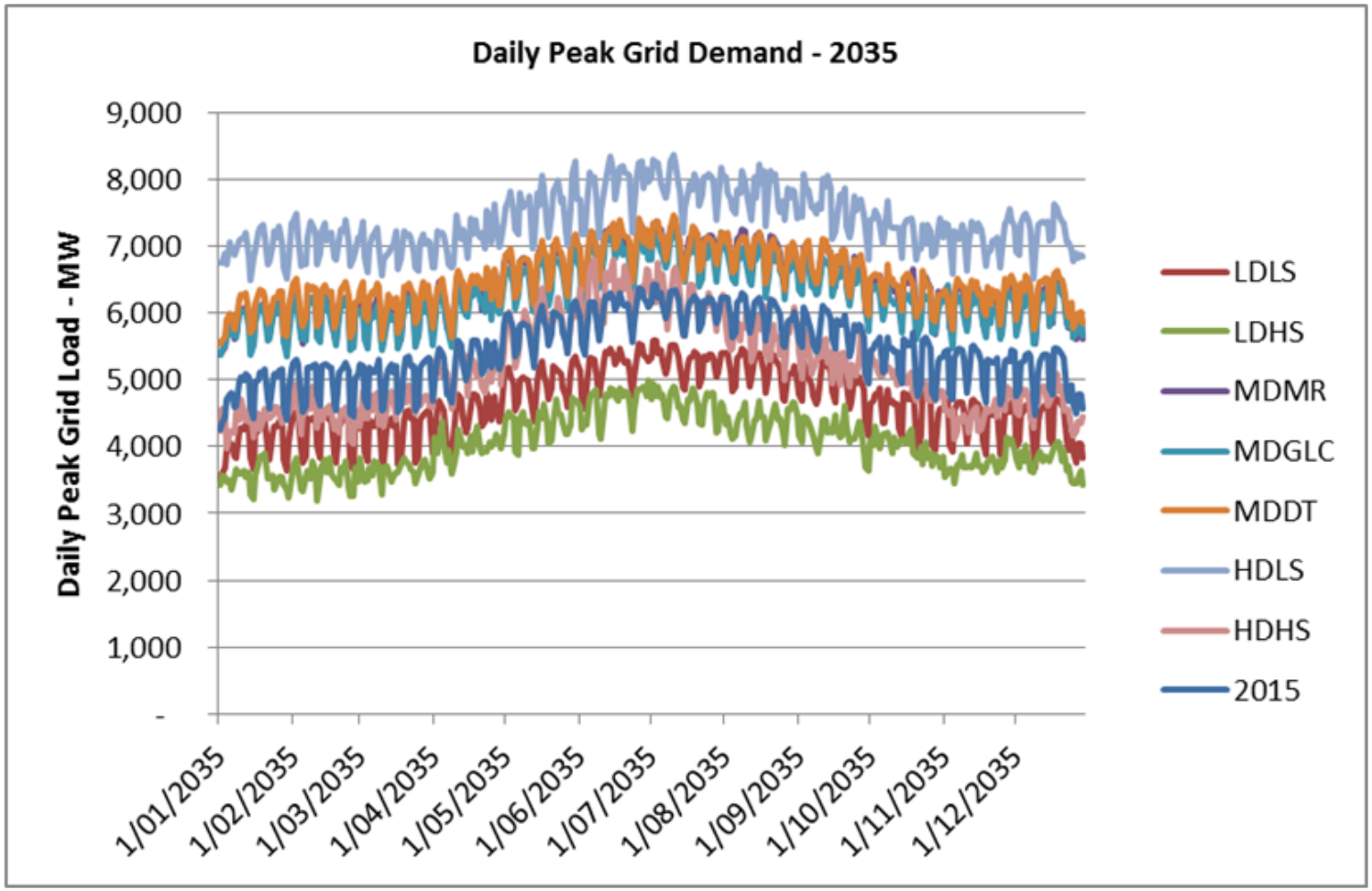
Initial findings

- We’re looking for three sets of results
  1. Inter-regional flows
  2. Total grid off-take
  3. Generation utilisation
- A few working results presented here and our initial findings

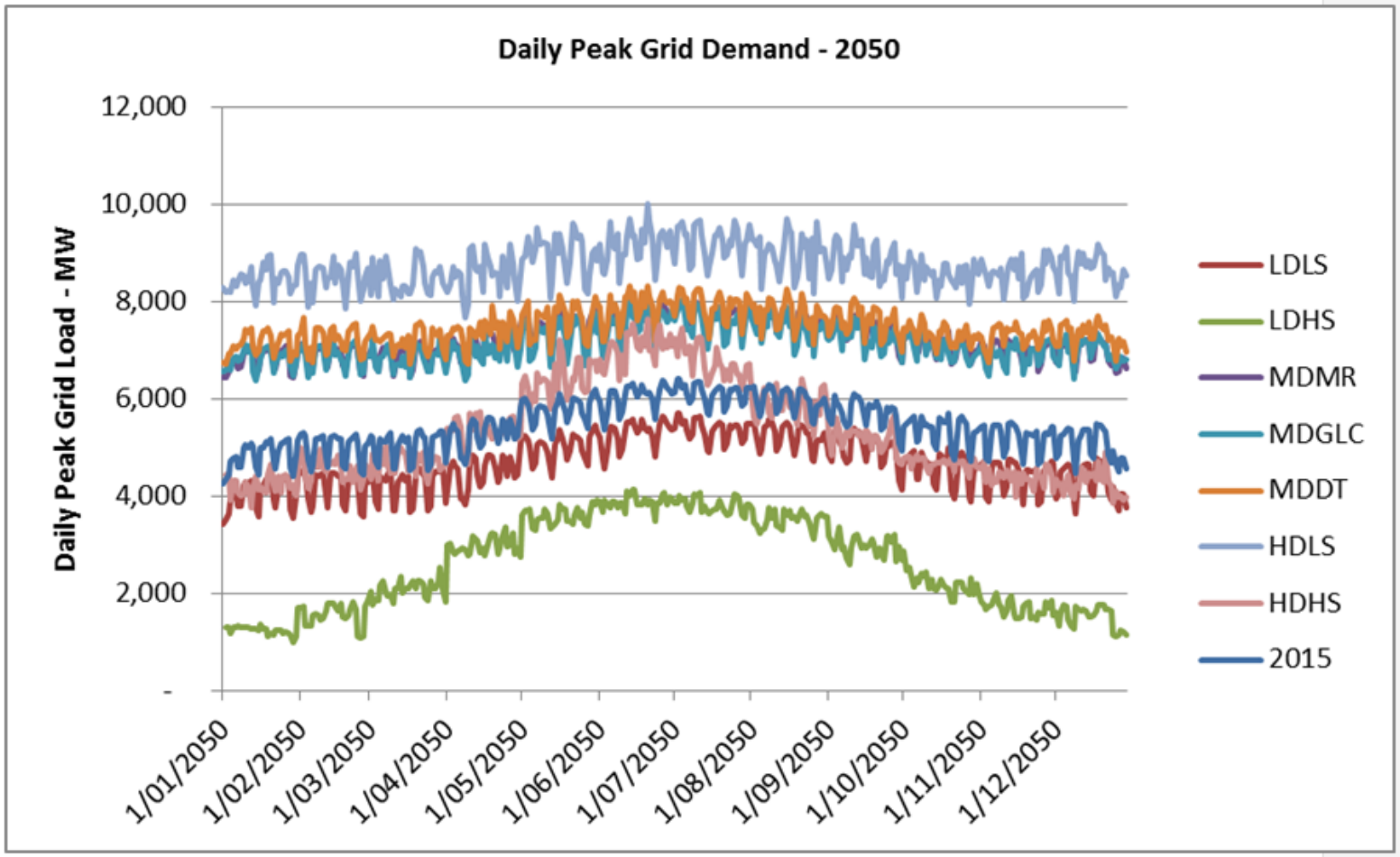
Total grid offtake 2020



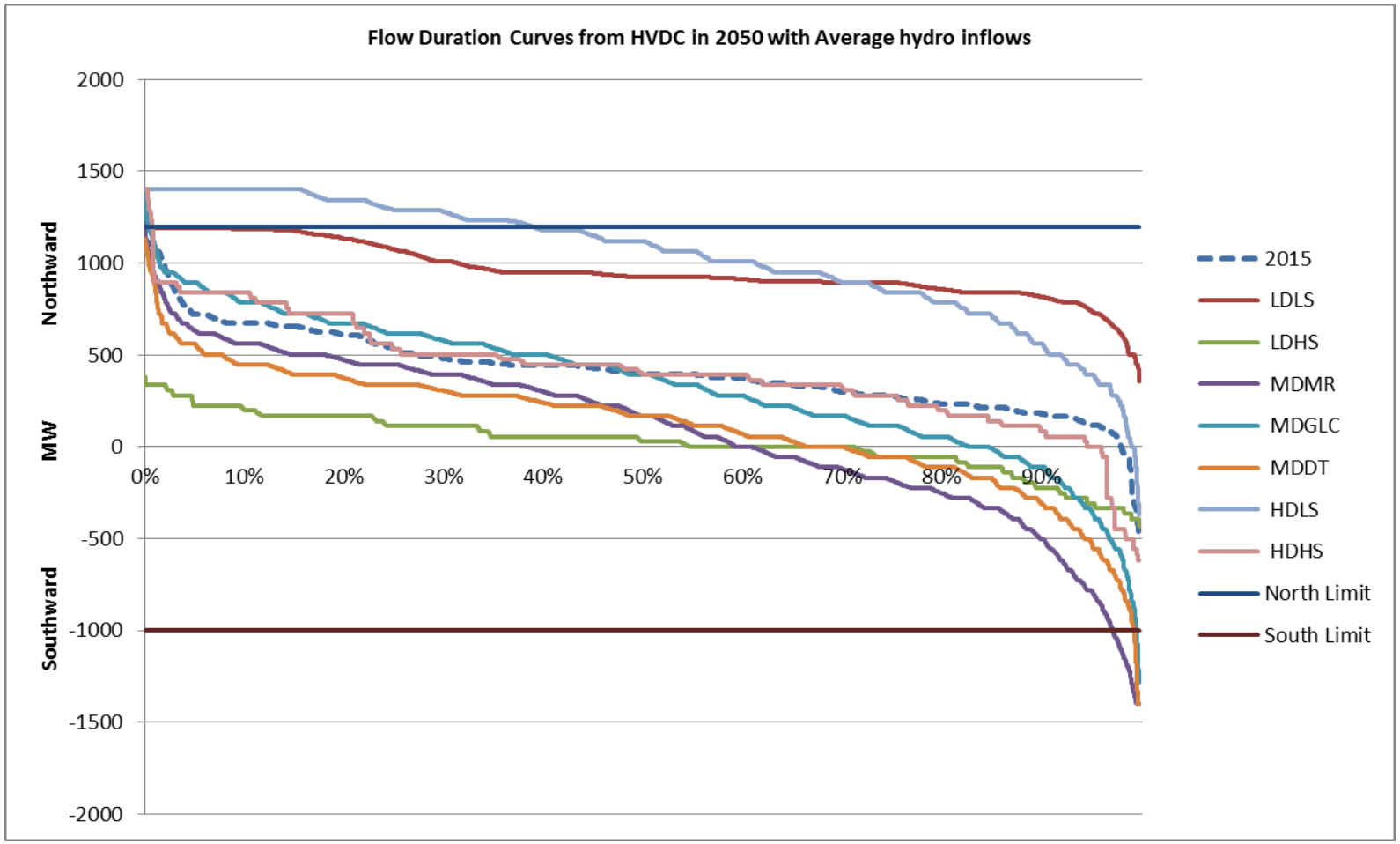
Total grid offtake 2035



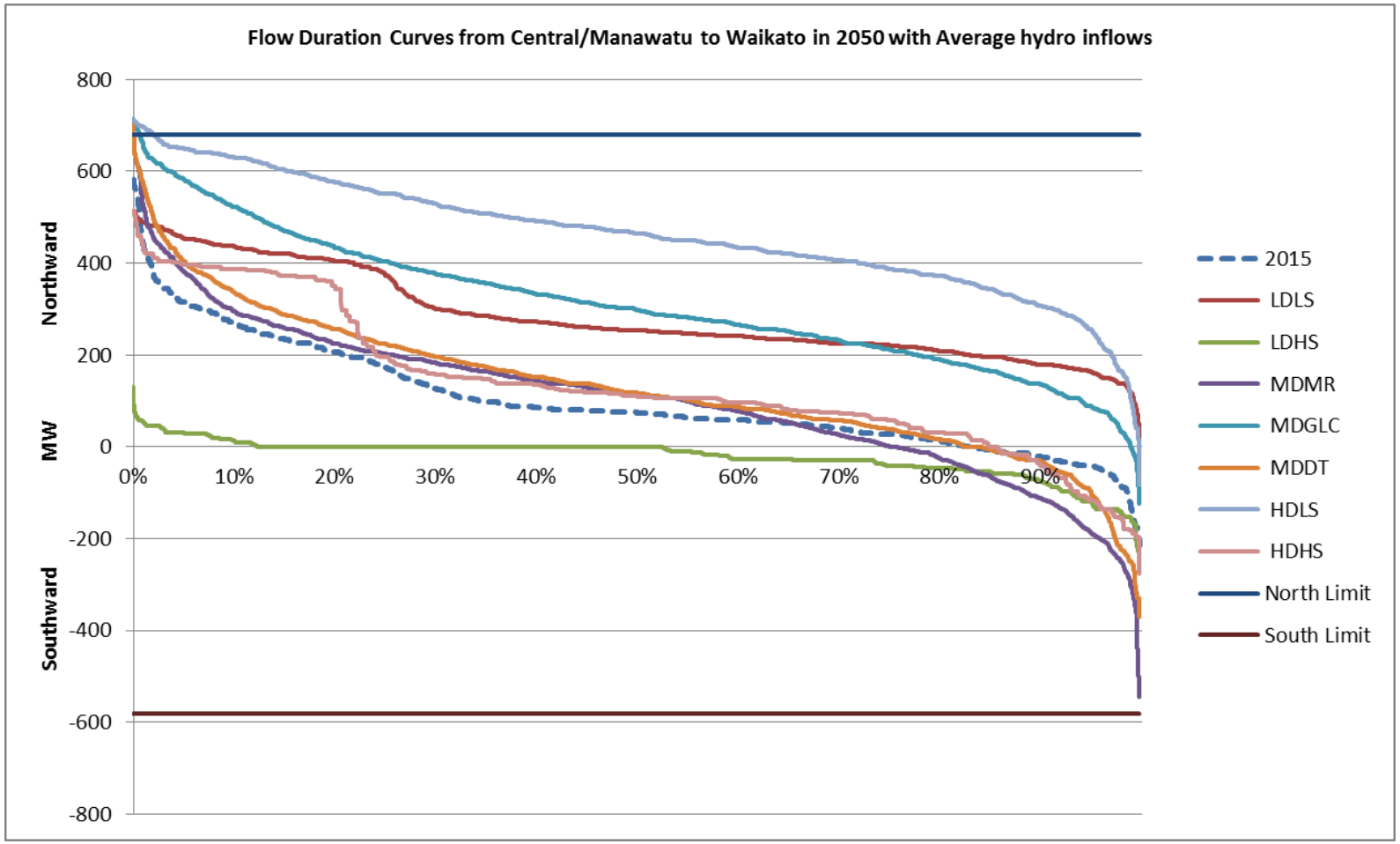
Total grid offtake 2050



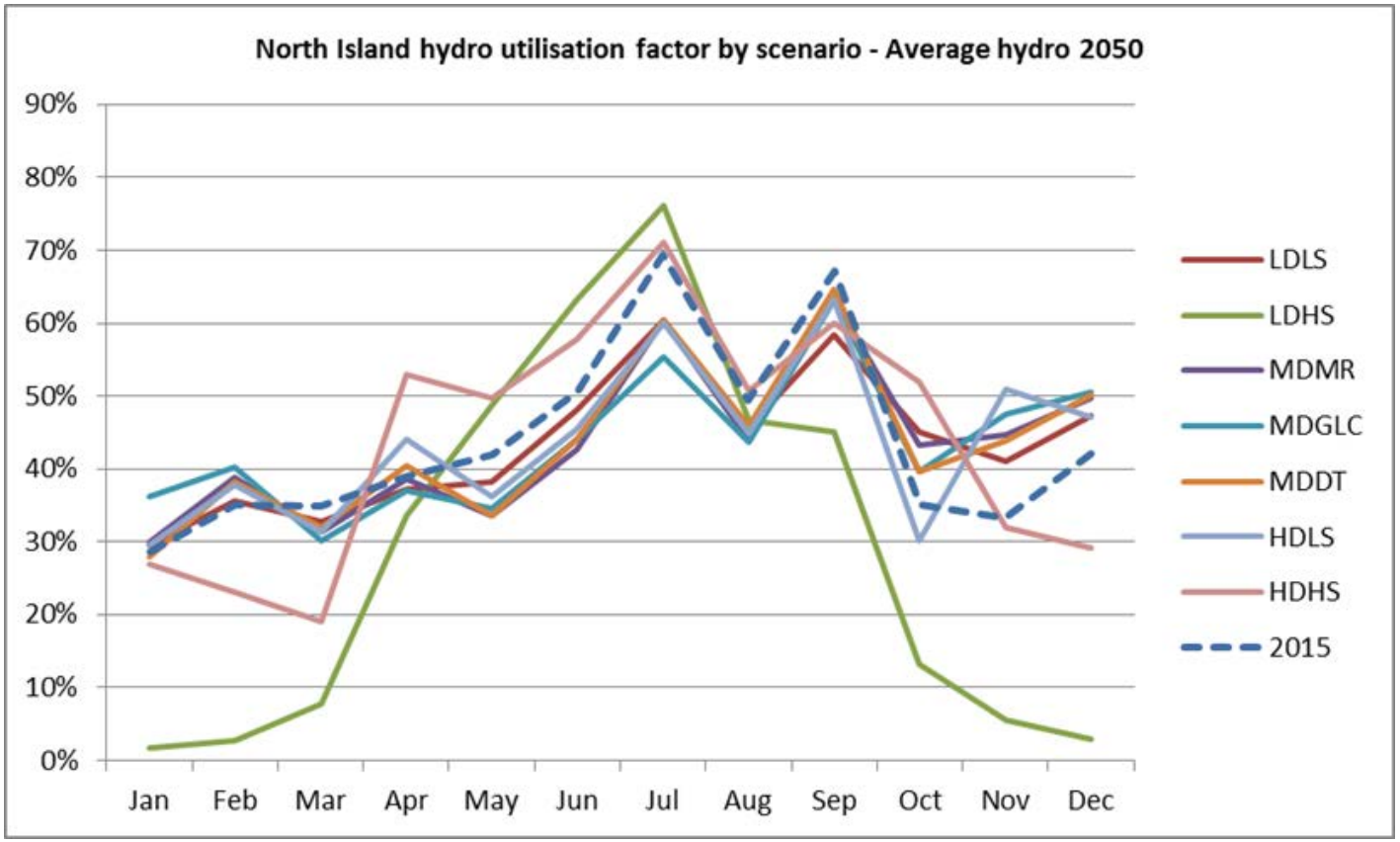
HVDC flows


Flow Duration Curves from HVDC in 2050 with Average hydro inflows
Northward
MW
Southward
2000
1500
1000
500
0
-500
-1000
-1500
-2000
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
2015
LDLS
LDHS
MDMR
MDGLC
MDDT
HDLS
HDHS
North Limit
South Limit

Central NI to Waikato



Hydro utilisation



Observations so far

- Need for a national grid remains under all scenarios
- Capacity between regions appears adequate with a few exceptions which we were already aware of.
- Under the more bold scenarios, the role of the backbone could change
- Under some scenarios, utilisation of existing renewables reduces a lot

Questions?