JADE at the Electricity Authority

EPOC Winter Workshop 2022

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9 September 2022

Outline

- Motivation – what is the problem we're currently focused on?
- Recap – how did we get here?
- JADE now open source – model code base and input datasets
- Replication
- Trading conduct – workflow to compute water values
- Water values

Motivation

- Current focus is trading conduct rules
  - Market monitoring team require water values to support their efforts in monitoring trading conduct
- Use of DOASA over the past several years for various studies – e.g. review of dry year performance and review of winter capacity and energy margins (security of supply) – highlighted aspects of model that could be improved
- Worked with EPOC (Andy and Tony) to transition from DOASA to JADE and to make it publicly available
- Expect JADE to be used in support of Authority work programme, e.g. future security and resilience – efficient transition to low-emissions system

Recap

- JADE at the Authority was introduced at the 2021 EPOC winter workshop
  - The next steps alluded to a year ago have now occurred – or are about to!
- DOASA at the Authority now superseded by JADE

JADE model and datasets to be released by 30 Sept 2022

JADE overview

Edit

JADE is a modelling package that implements a multistage stochastic optimization representing the New Zealand electricity generation sector, with a rich treatment of the hydrological aspects of the sector. Key outputs of the model include a water value surface for each stage or week of the modelled time horizon, typically a year, and corresponding marginal water values for each reservoir represented in the model.

One of the difficulties with planning and operational decision making in a hydro-dominated electricity system such as New Zealand's is the uncertainty and variability associated with inflows into hydro storage reservoirs. JADE is an ideal tool to aid decision making in the presence of such uncertainty.

Some high-level characteristics of JADE:

- The EPOC team at Auckland University created and maintain the JADE modelling package. Significant contributions over the years have come from A Philpott, G Pritchard, A Downward, O Dowson, and L Kapelevich.
- JADE supersedes DOASA, another EPOC model that the Authority has used for several years.
- JADE is formulated using the JuMP package, an algebraic modelling language for mathematical optimization written in the Julia programming language.
- At the heart of JADE is the Julia package for stochastic dual dynamic programming by Oscar Dowson, SDDP.jl.
- JADE can be solved with open-source solvers, although for any meaningful implementation a commercial solver requiring a paid license is recommended, e.g. Gurobi or Cplex.
- JADE is open source and available from GitHub.

JADE datasets

The Authority will make JADE input datasets available at least annually or whenever a significant change on the electricity system needs to be included in the modelling. In addition, marginal water values and the input data required to compute them will be published on a weekly basis.

Over time we will endeavour to continually improve the quality of the JADE input dataset.

If you have any questions or comments regarding our JADE input datasets, please contact us at emi@ea.govt.nz.

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Access to JADE

By 30 September 2022

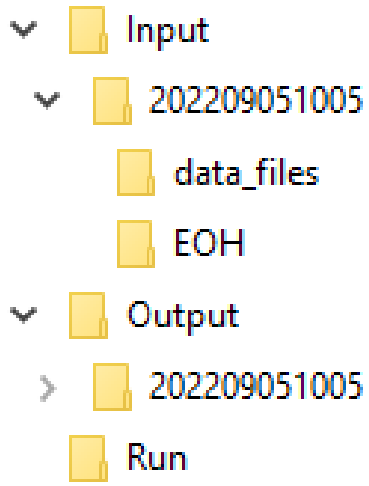
- The model:
  - https://github.com/epoc-nz/jade
  - Mozilla Public License Version 2.0
- Core datasets:
  - https://www.emi.ea.govt.nz/Wholesale/Datasets/JADE
  - Updated at least annually
  - Or when a significant change to the electricity system occurs
- Water values by week and by reservoir (i.e. in support of trading conduct monitoring)
  - https://www.emi.ea.govt.nz/Environment/Datasets/ExpectedWaterValues
- Documentation – coming soon!
  - Model: available from the GitHub repo and EPOC website
  - Data: Authority paper describing data sources and operation of model

Workflow – using JADE to support monitoring of trading conduct

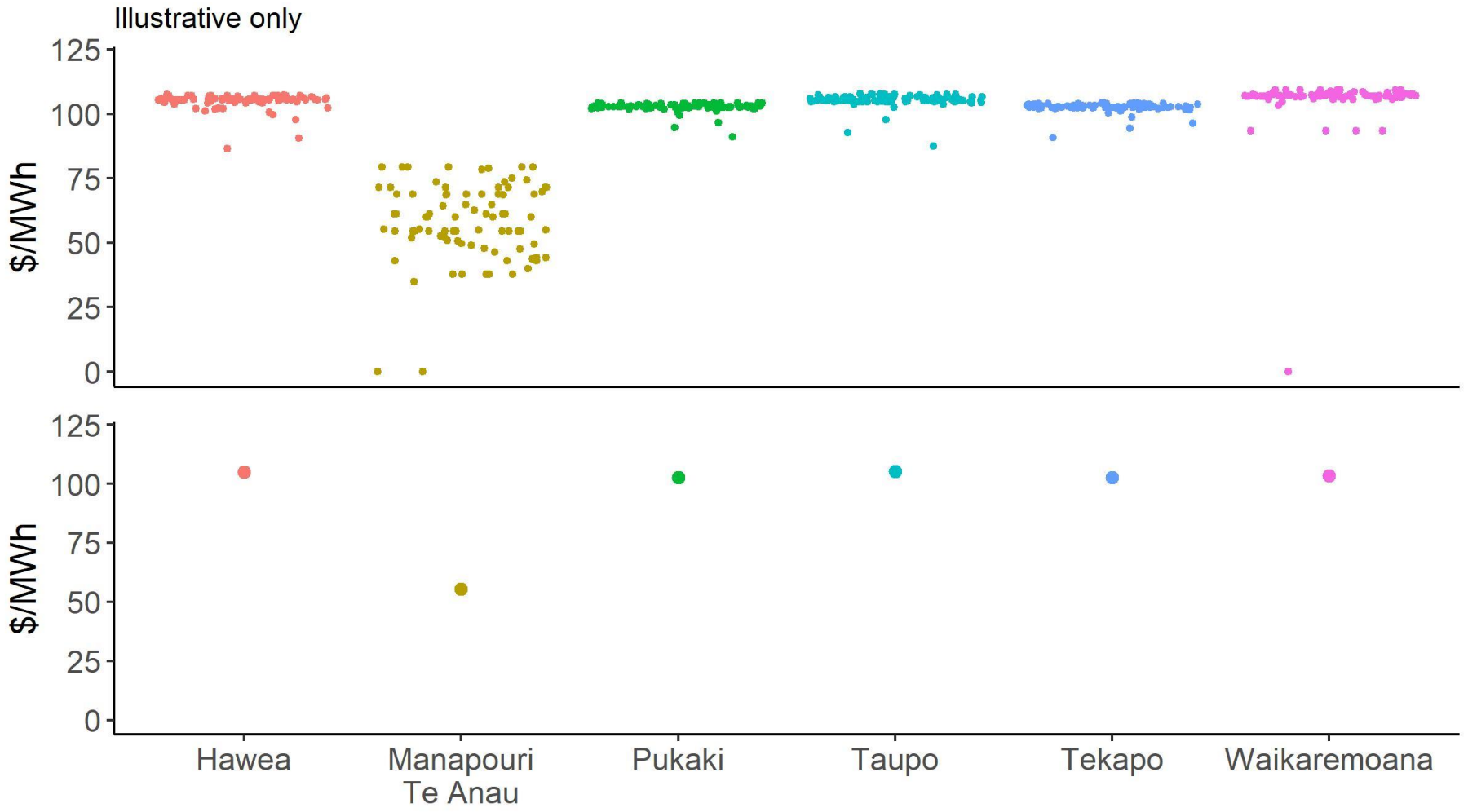
- **Step 1:**
  - Run model for 52 weeks (stages)
  - Main purpose is to generate a steady state water release policy in presence of uncertain inflows
  - Assumption laden: Risk neutrality, single scenario re: demand forecast, fuel prices
- **Step 2:**
  - Retrain/refine water release policy for week in question
  - Operate model in finite horizon mode, informed by steady state solution, i.e. terminal water values for current week drawn from steady state solution → improve approximation of release policy in the neighbourhood of the current state
  - Update current state with observed information, i.e. initial reservoir storage levels, and revised forecasts, e.g. demand, outages, fuel costs
- **Step 3:**
  - Simulate refined release policy over historical inflow sequences to determine expected water values by reservoir for current week

Replication

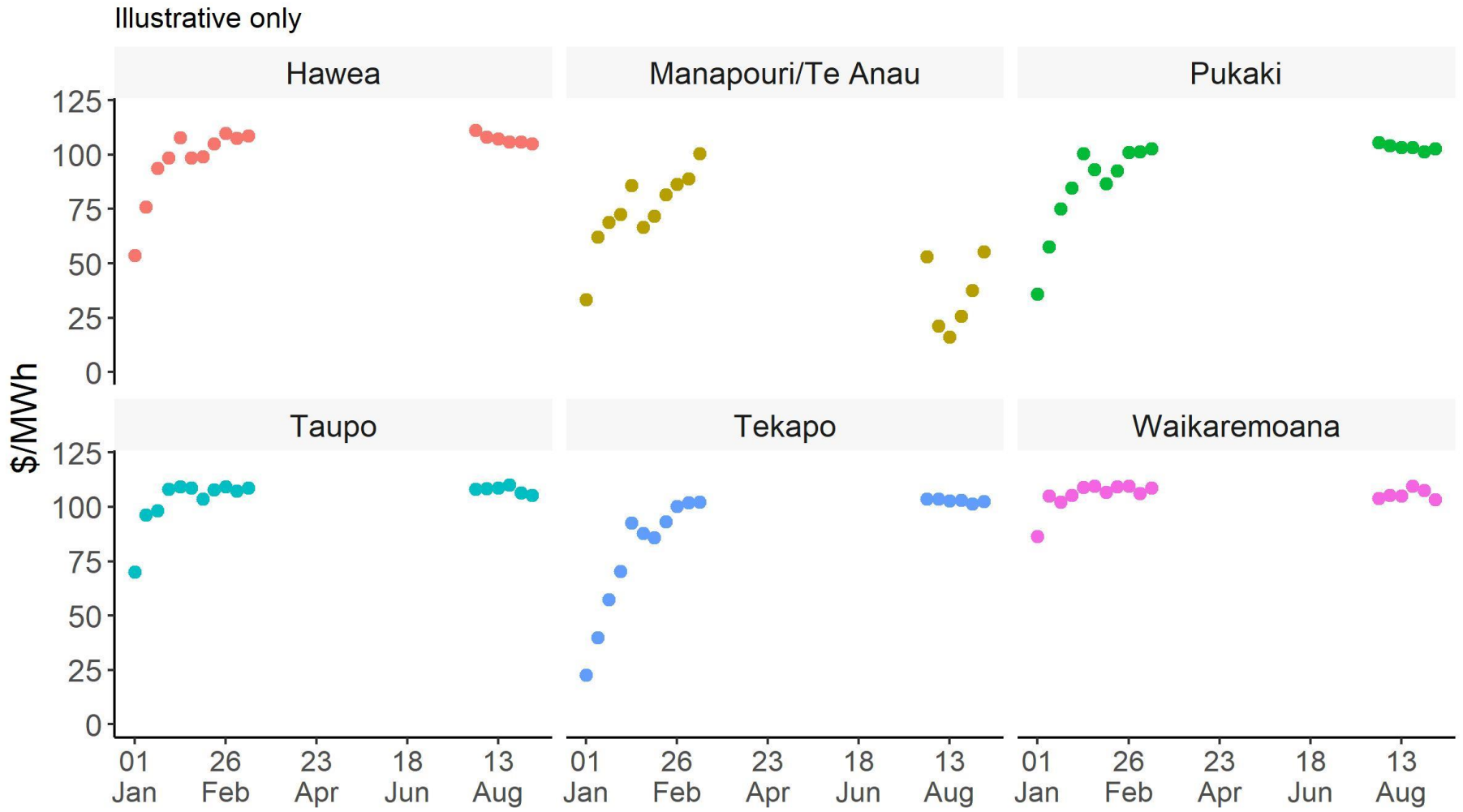
- Each week, all of the model input data, model configuration settings (the run file), and model outputs will be published on EMI
- Precise folder structure / nomenclature yet to be finalised; likely to be something like that shown below
- Transparency of water value derivation / computation process coupled with availability of model and data is expected to encourage informed critique



Expected marginal water values – week 36 (week beg. 3 Sep 2022)



Weekly expected marginal water values (1 Jan – 3 Sep 2022)



Weekly expected marginal water values (1 Jan – 3 Sep 2022)