Estimating the technical potential for residential Demand Response in New Zealand

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AGENDA

01 **The Challenge**
Demand variability and congestion periods

02 **Demand Side Management**
Demand Response in contrast to Energy Efficiency

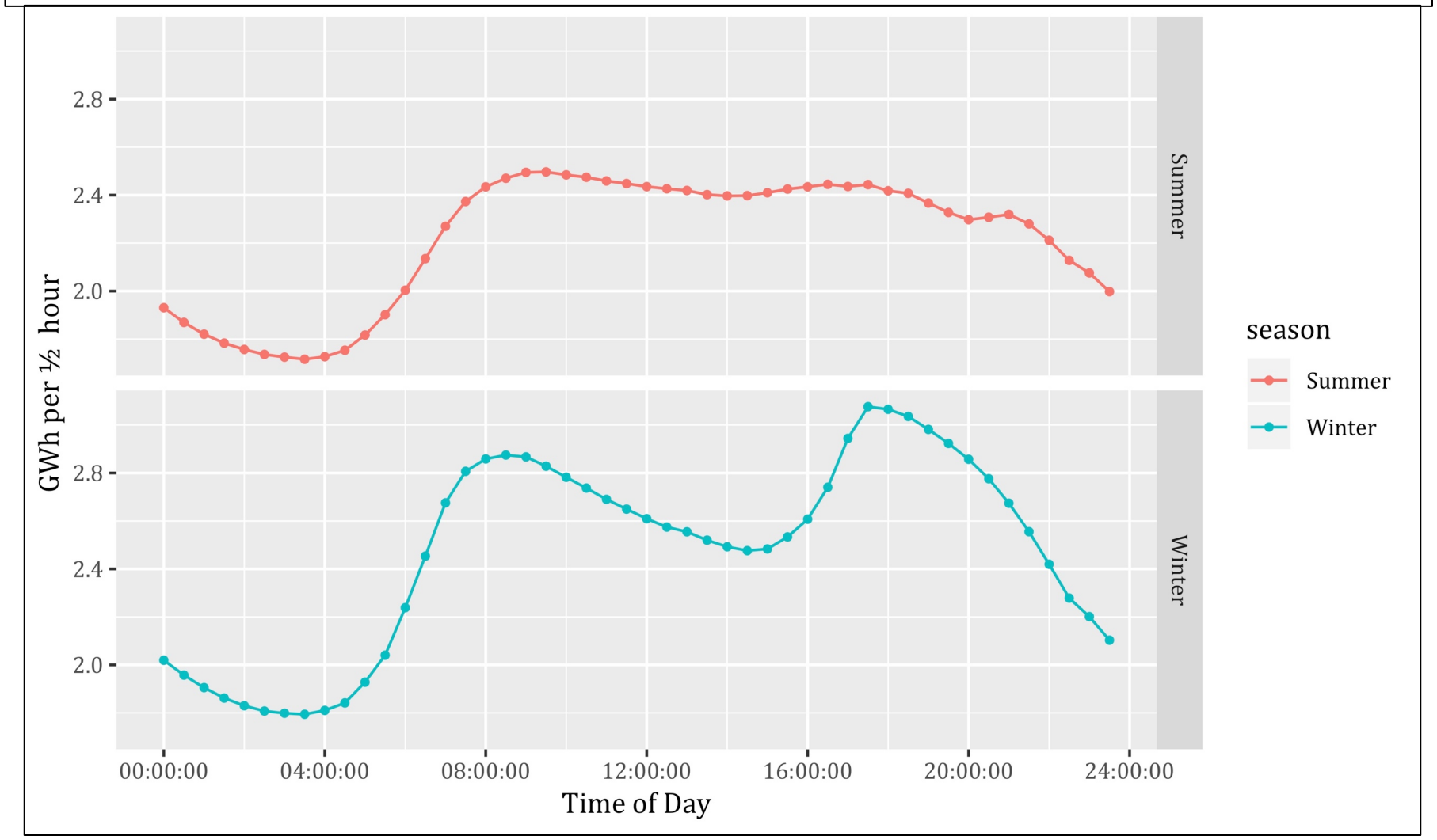
03 **Methods**
Scenario-based analysis and economic estimation

04 **Results**
Maximum demand and energy potential of DR. Impact of DR on national electricity generation and economic evaluation

05 **Limitations**
Limitations and opportunities to enhance future work

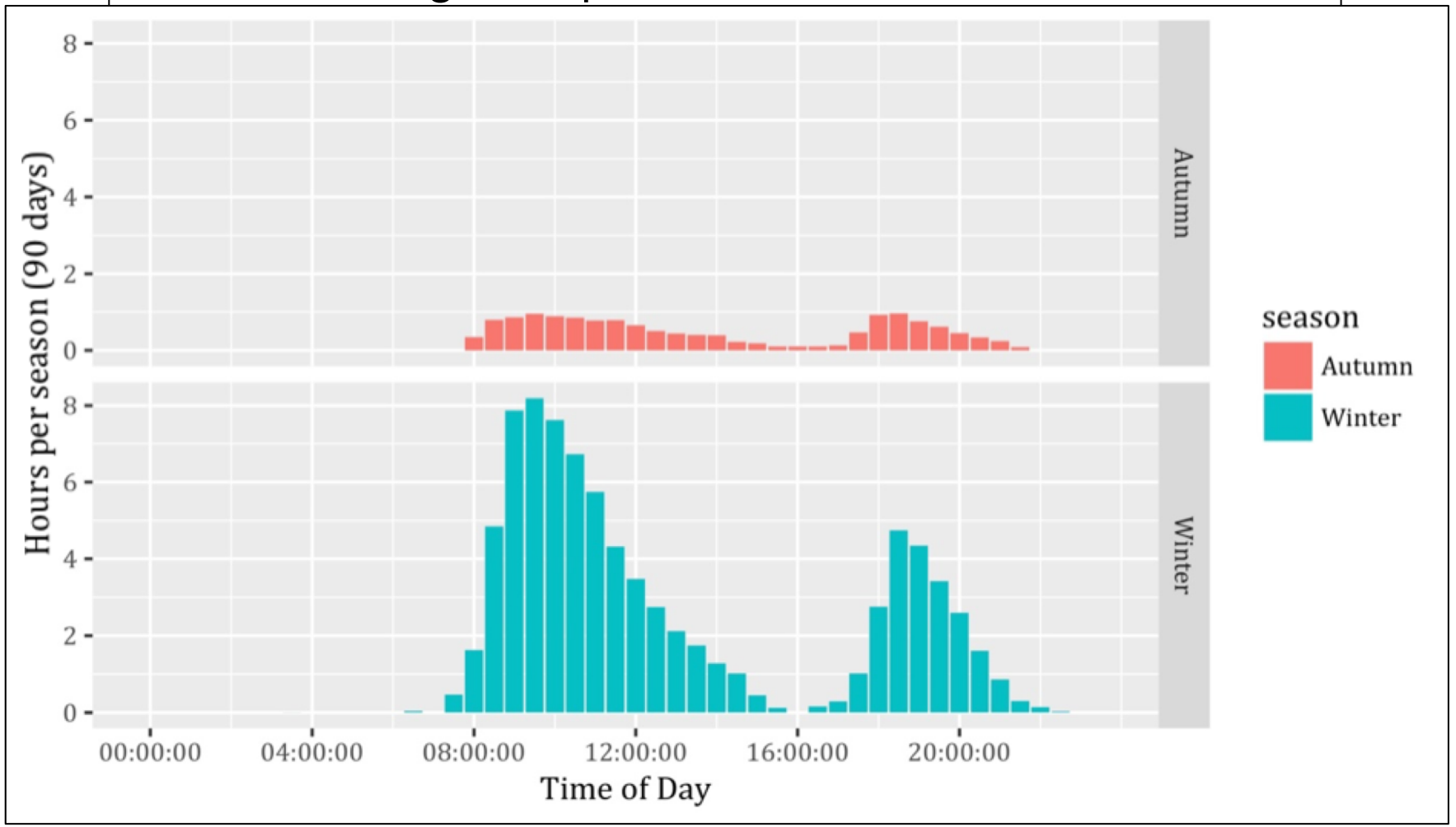
Demand volatility

Daily average half-hour electricity generation profile in summer and winter



Congestion periods

Duration of congestion period demand events for autumn and

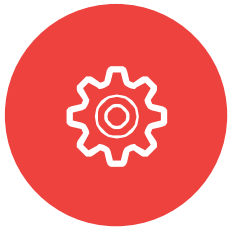


Two Approaches

DEMAND SIDE MANAGEMENT

DEMAND RESPONSE

Change of instantaneous demand, timing of electricity consumption, response to electricity price changes or to incentive payments

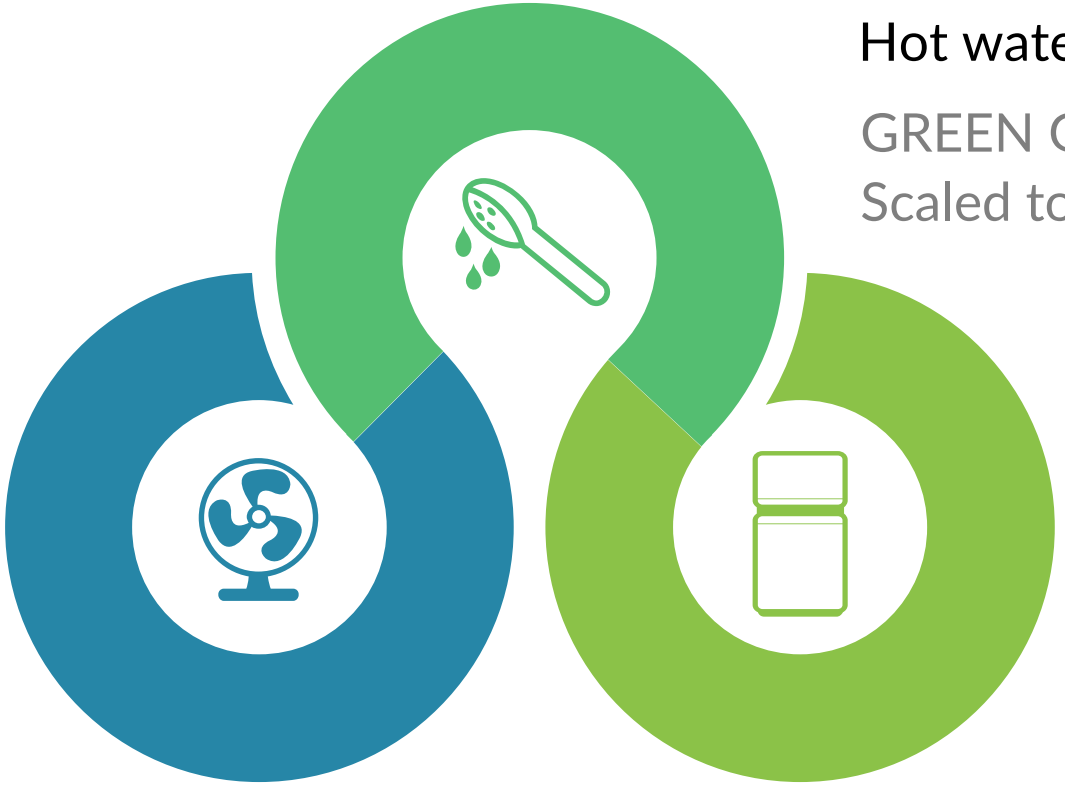


ENERGY EFFICIENCY

Reduces electricity demand in general

Does not taker variable conditions in electricity generation into account

Demand profiles



Hot water heaters

GREEN Grid monitored
Scaled to 3,313GWh p.a

Heat pumps

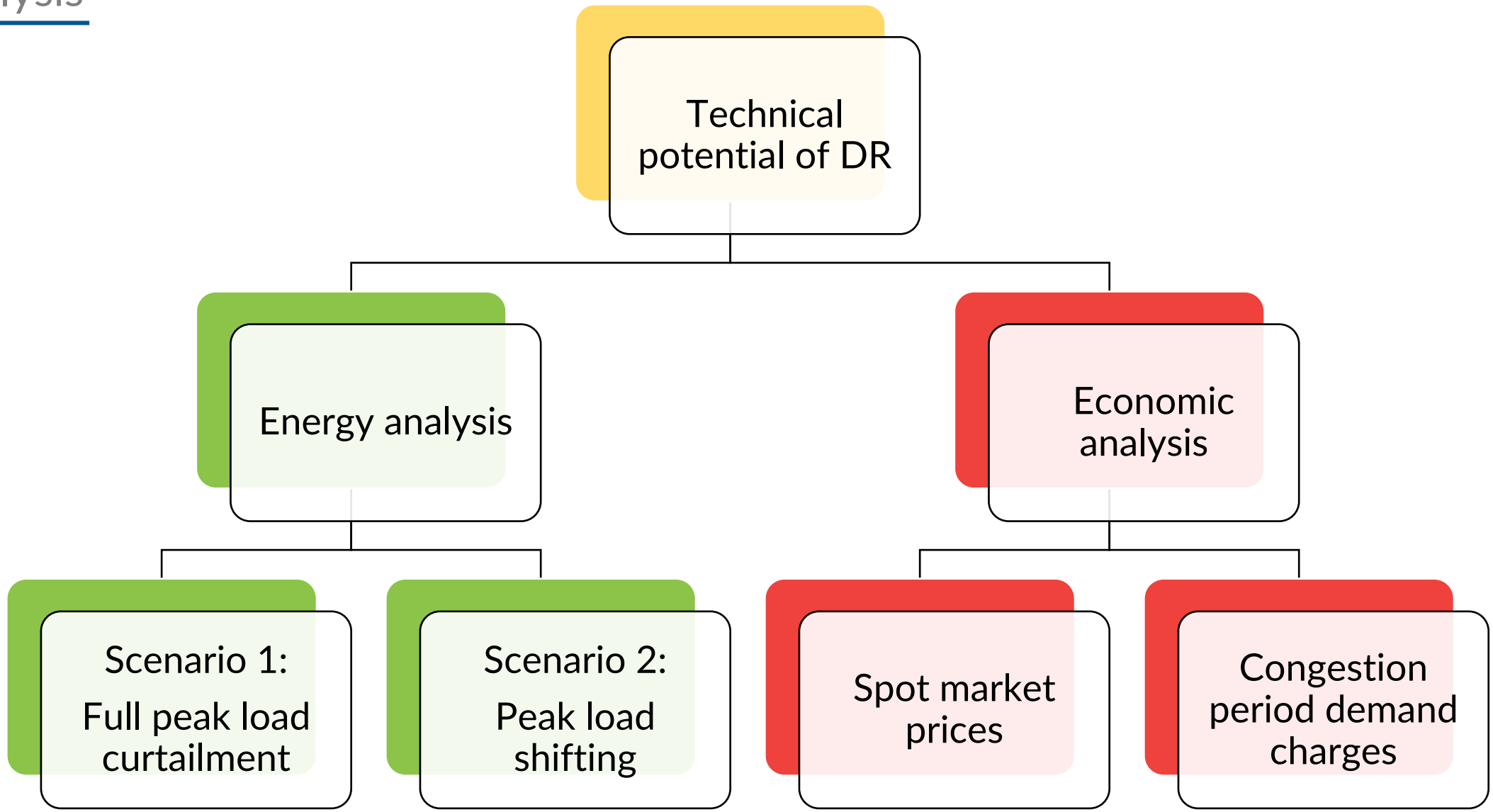
GREEN Grid monitored
Scaled to 638GWh p.a

Refrigerators

Flat profile
Scaled to 2,074 GWh p.a

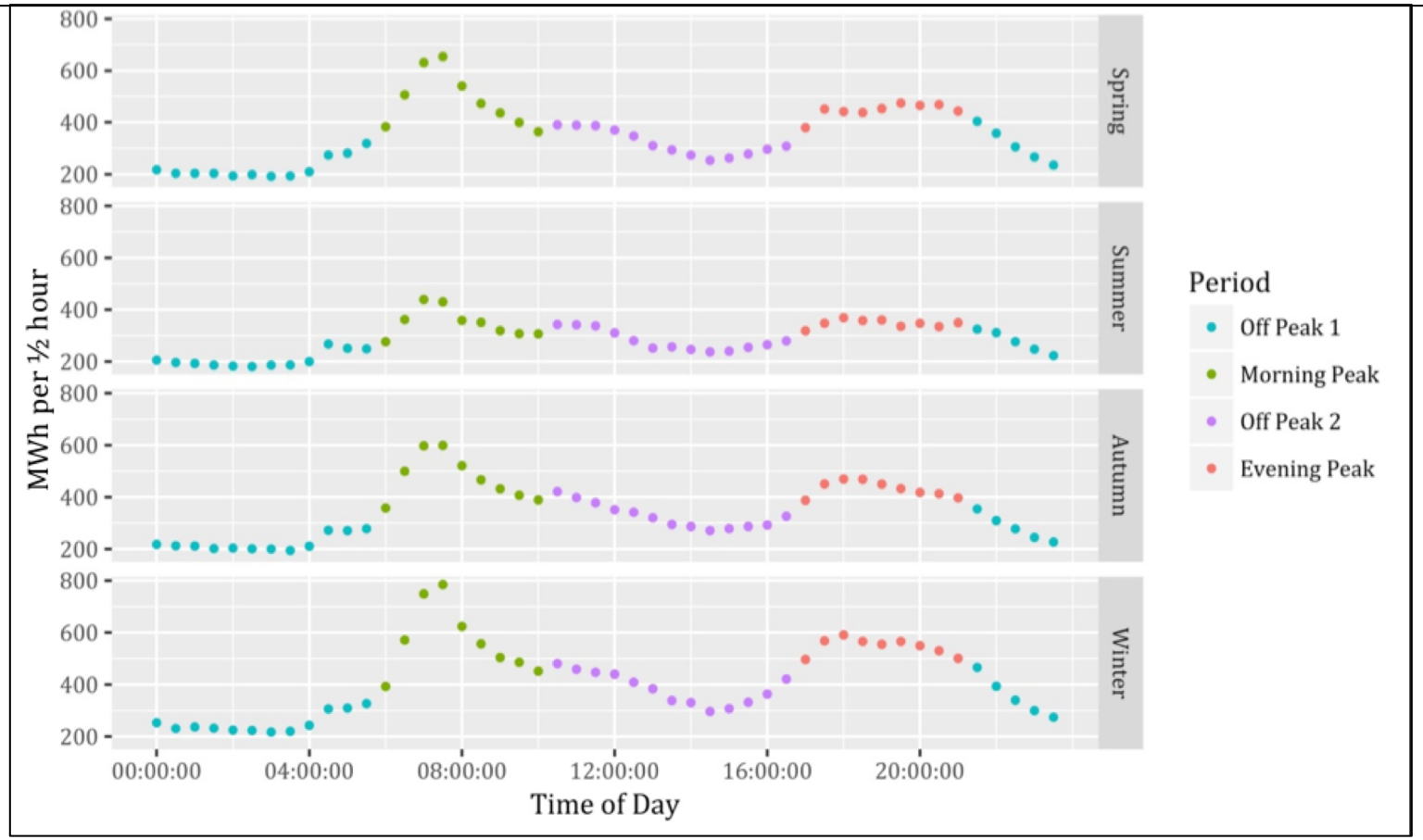
- **50% of total residential household electricity**
- **Electricity demand can in principle be shifted**

Analysis


Technical potential of DR
Energy analysis
Economic analysis
Scenario 1: Full peak load curtailment
Scenario 2: Peak load shifting
Spot market prices
Congestion period demand charges

Demand and Energy

Daily average total energy consumption profile for HP, HW, REF*1



Demand Morning Peak

Summer: Max. 860 MW

Winter: Max. 1,600 MW

Energy Morning Peak

Summer: 3,150 MWh per day

Winter: 5,120 MWh per day*2

Demand Evening Peak

Summer: Max. 760 MW

Winter: Max. 1,200 MW

Energy Evening Peak

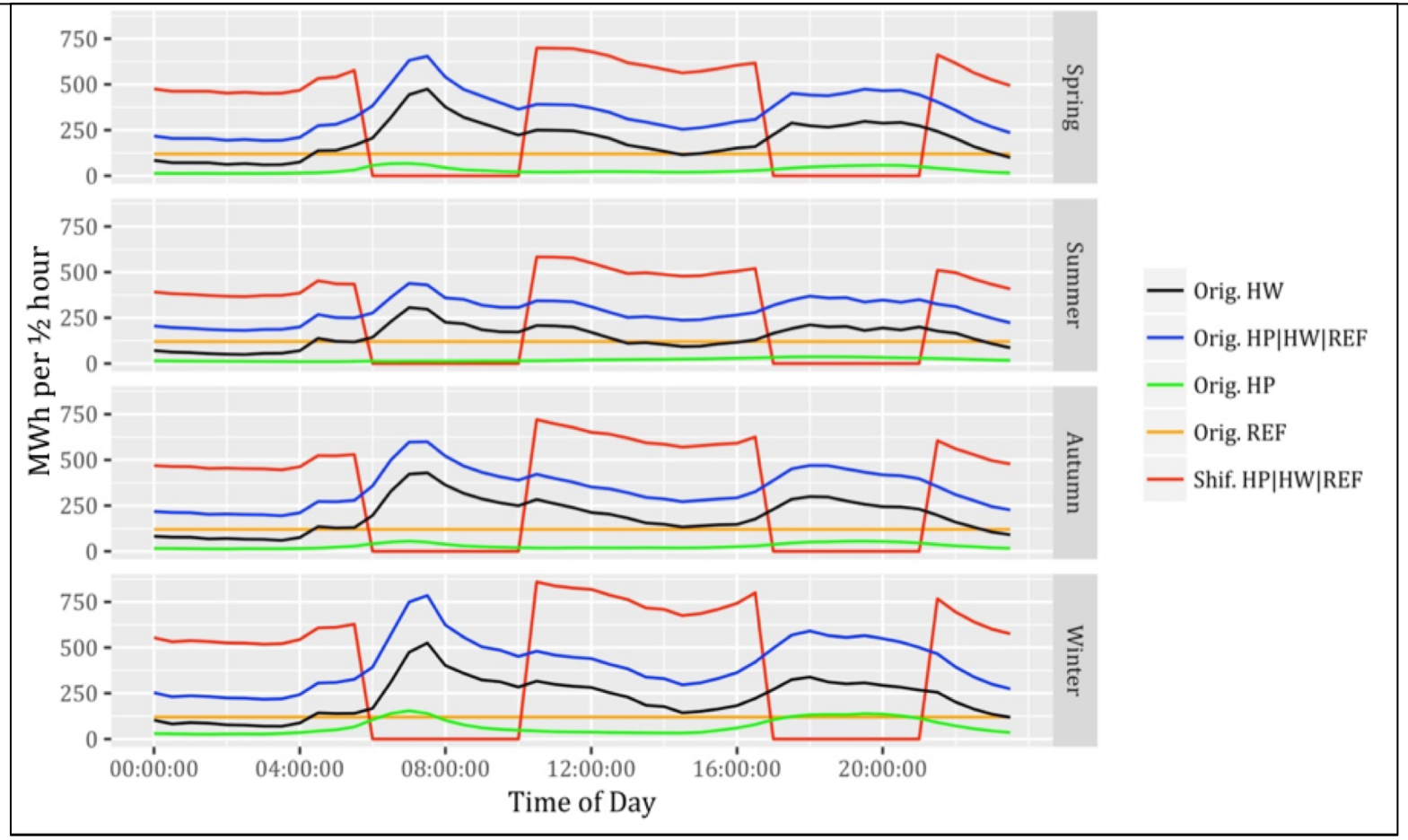
Summer: 3,120 MWh per day

Winter: 4,920 MWh per day

*1HP=Heat Pumps, HW=Hot Water Heaters, REF=Refrigerators; *2Equivalent of running Huntly Power Station for 5.5 hours per day

Load shifting

Estimated total load shifting profile for HP, HW, and REF (scenario 2)



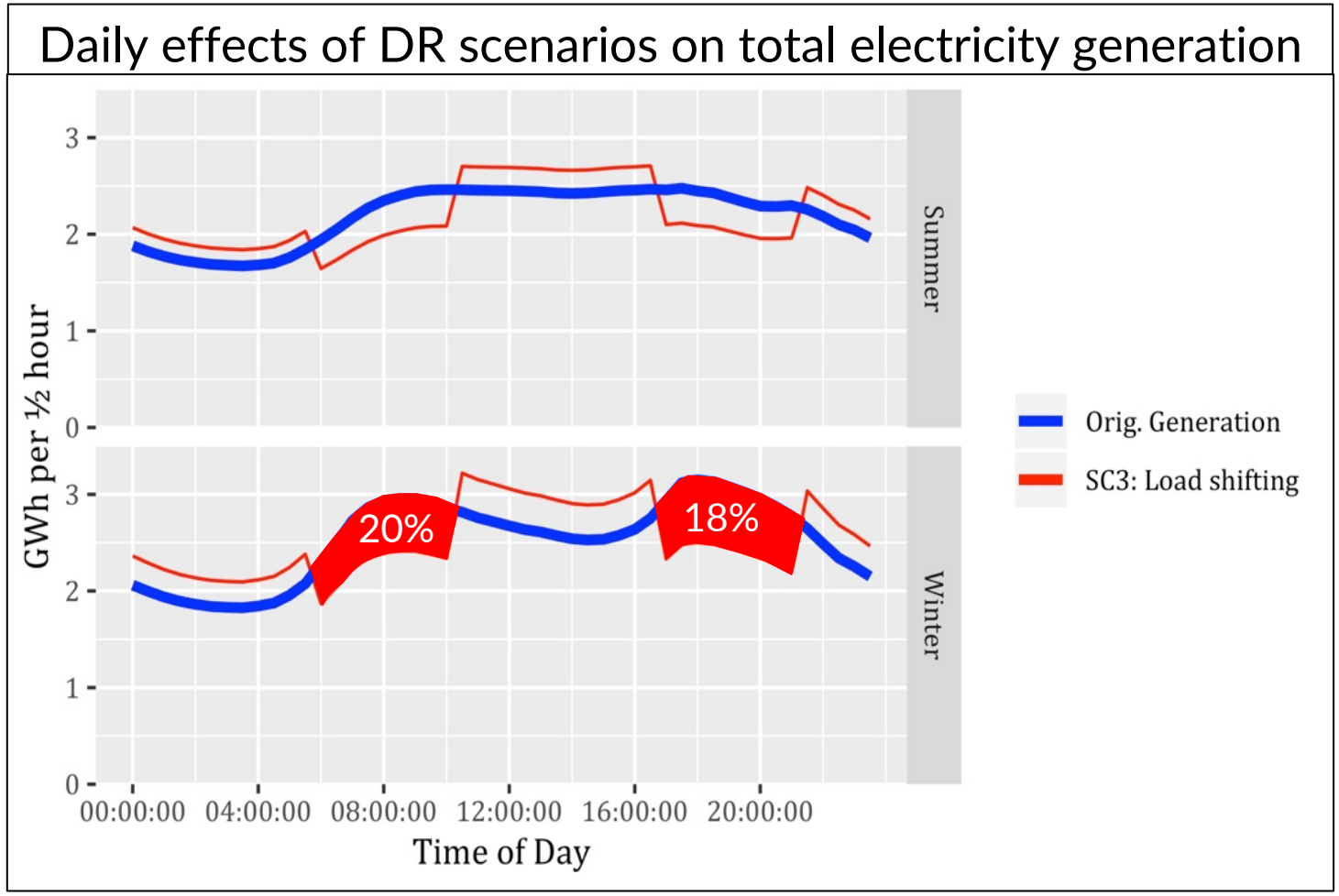
Individual appliance demand as well as aggregated group demand

Load reduction to zero at peak demand

Load of peak times is equally spread over the prior period

New maximum demand
1,740 MW
(previously 1,600 MW)

Effects of DR



Applying load shifting reduces electricity generation per day at peak times by:

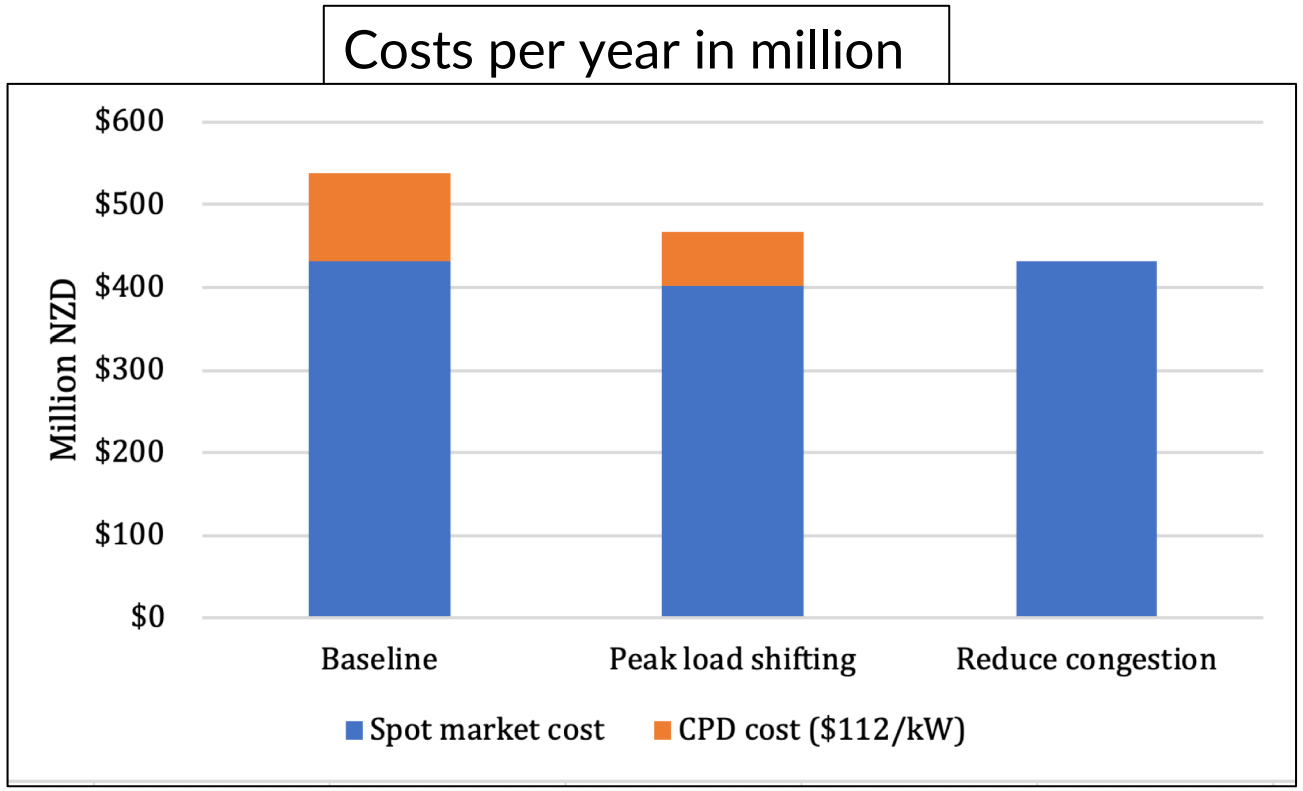
Summer:
Morning Peak: 15 %
Evening Peak: 14 %

HW	REF	HP
8%	5%	1%
9%	5%	1%

Winter:
Morning Peak: 20 %
Evening Peak: 18 %

HW	REF	HP
10%	4%	4%
12%	4%	4%

Economic analysis



Annual cost predominately determined by hot water heaters and refrigeration

Annual cost without DR: $539M

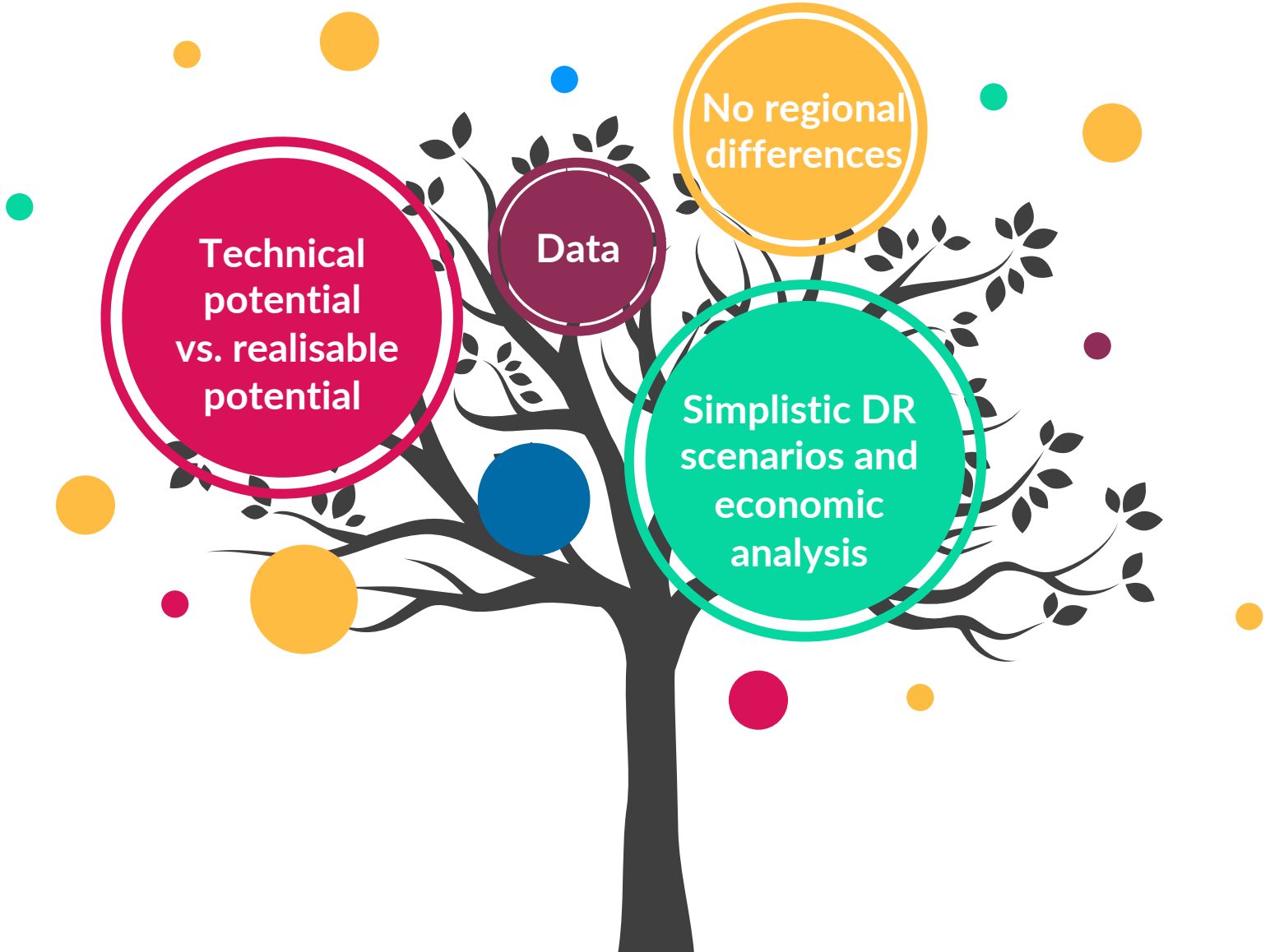
Savings per year with DR:

Load shifting: $72M

Reduce congestion: $107M*1

*1In contrast to load shifting, ”reduce congestion” reduces energy consumption only for ~ 100 hours per year

Overview


No regional differences
Technical potential vs. realisable potential
Data
Simplistic DR scenarios and economic analysis

Thank you for your attention

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