Transmission 2040

Work package 1 - Scenarios

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TRANSPOWER

Scenarios

- A matter of understanding…
- Compared with quantitative modelling/forecasting, scenarios gives a systematic approach to uncertainty, scope for dealing with radical system changes, and less easily quantified drivers, such as culture and politics.
  - Cheshire and Surrey (1975): “computation becomes a substitute for understanding”
- Based on the understanding, quantification still have to be made to form the inputs to the transmission need assessment.
- Modelling allows analysis of multiple (quantitative) interacting drives

Outline

- Purpose of today
- Scenario objectives and design
- Assumptions
  - Demand
  - Generation
- Quantification
- Next steps

Purpose of today

- This work package is at its mid point
  - Present draft scenarios
  - Obtain feedback on draft scenarios
- Means of feedback:
  - Discussion after this presentation and reviews
  - Handout questionnaire
  - Submissions to consultation document
  - Personal contact

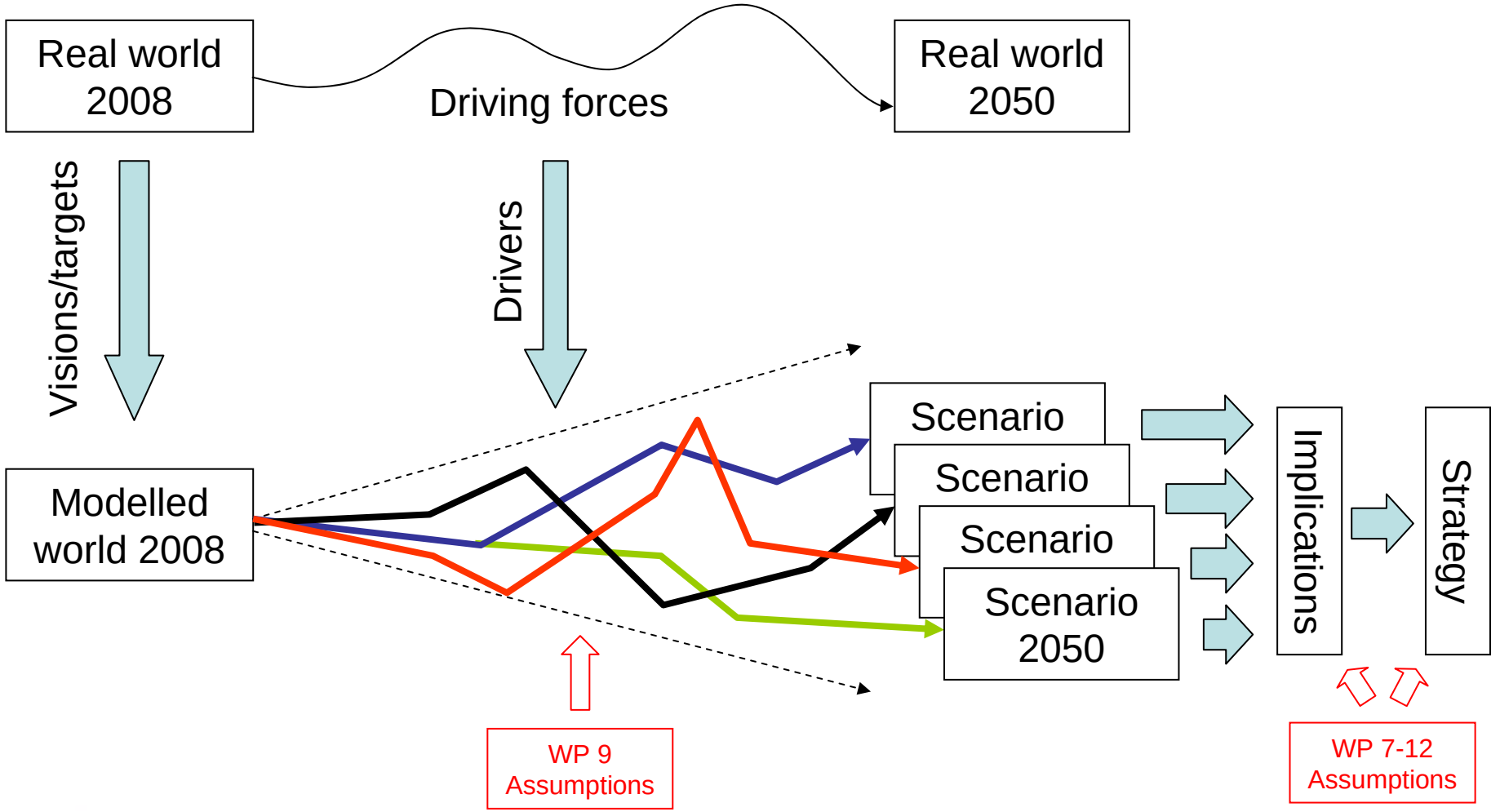
Scenario objective

Objective of scenario work package: *To identify future demands for transmission services out to 2050 on a regional basis*

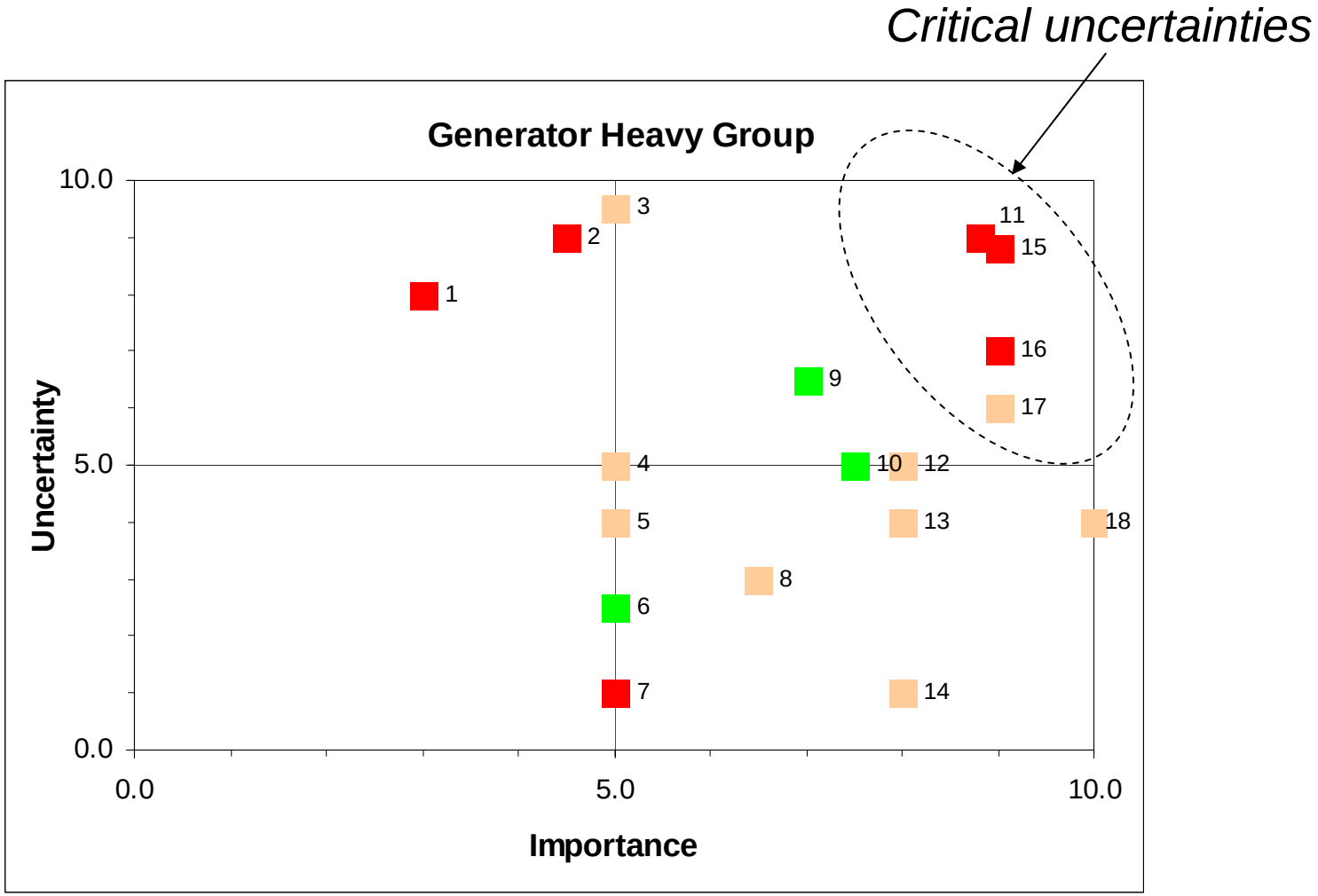
Transmission services:

- Connects generation with consumers
- Can provides different service levels
  - (e.g. N-1 vs. N security)
- Facilitates an effective electricity market

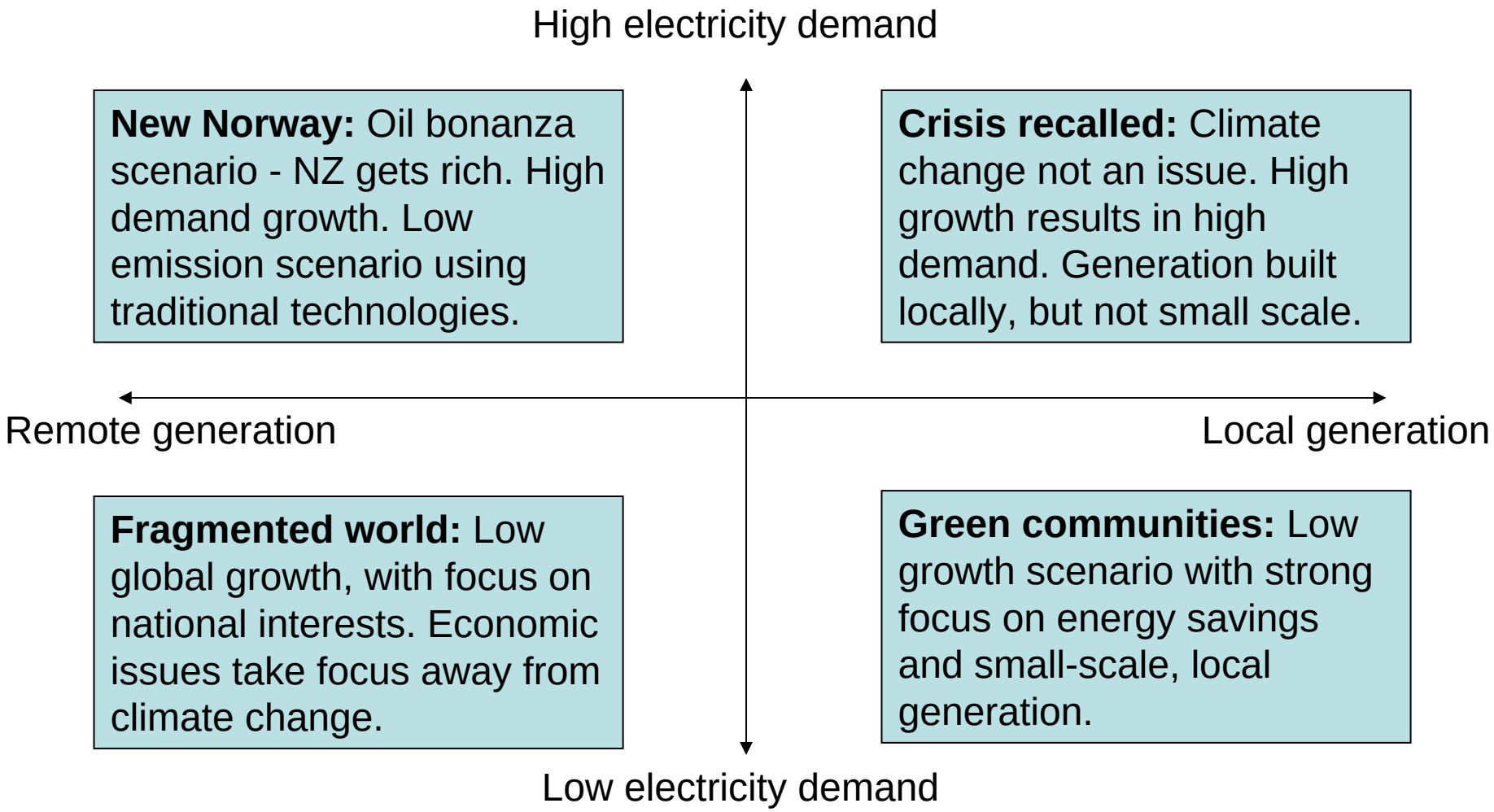
Scenario framework



Driver identification

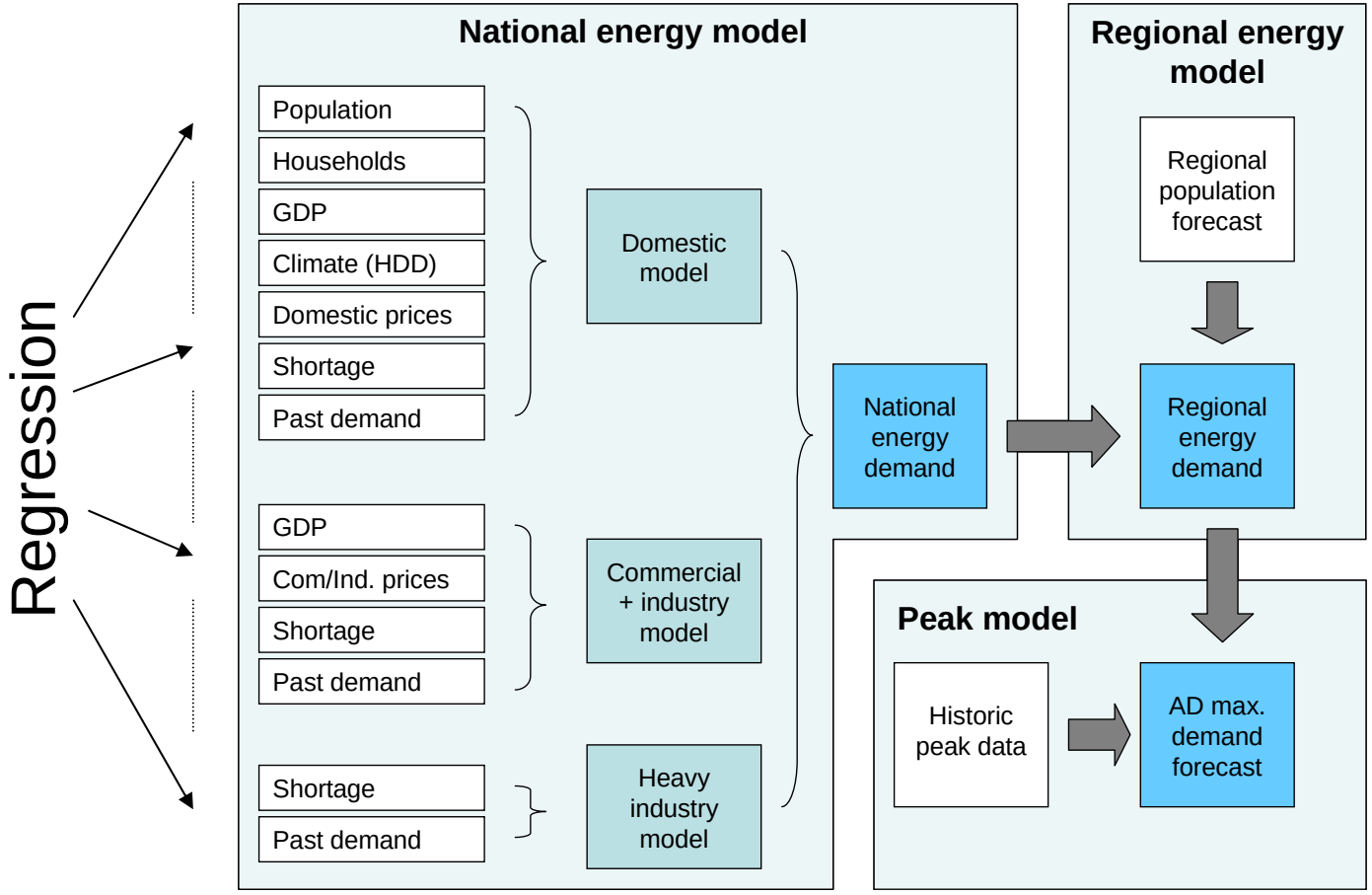


Selection of dimensions

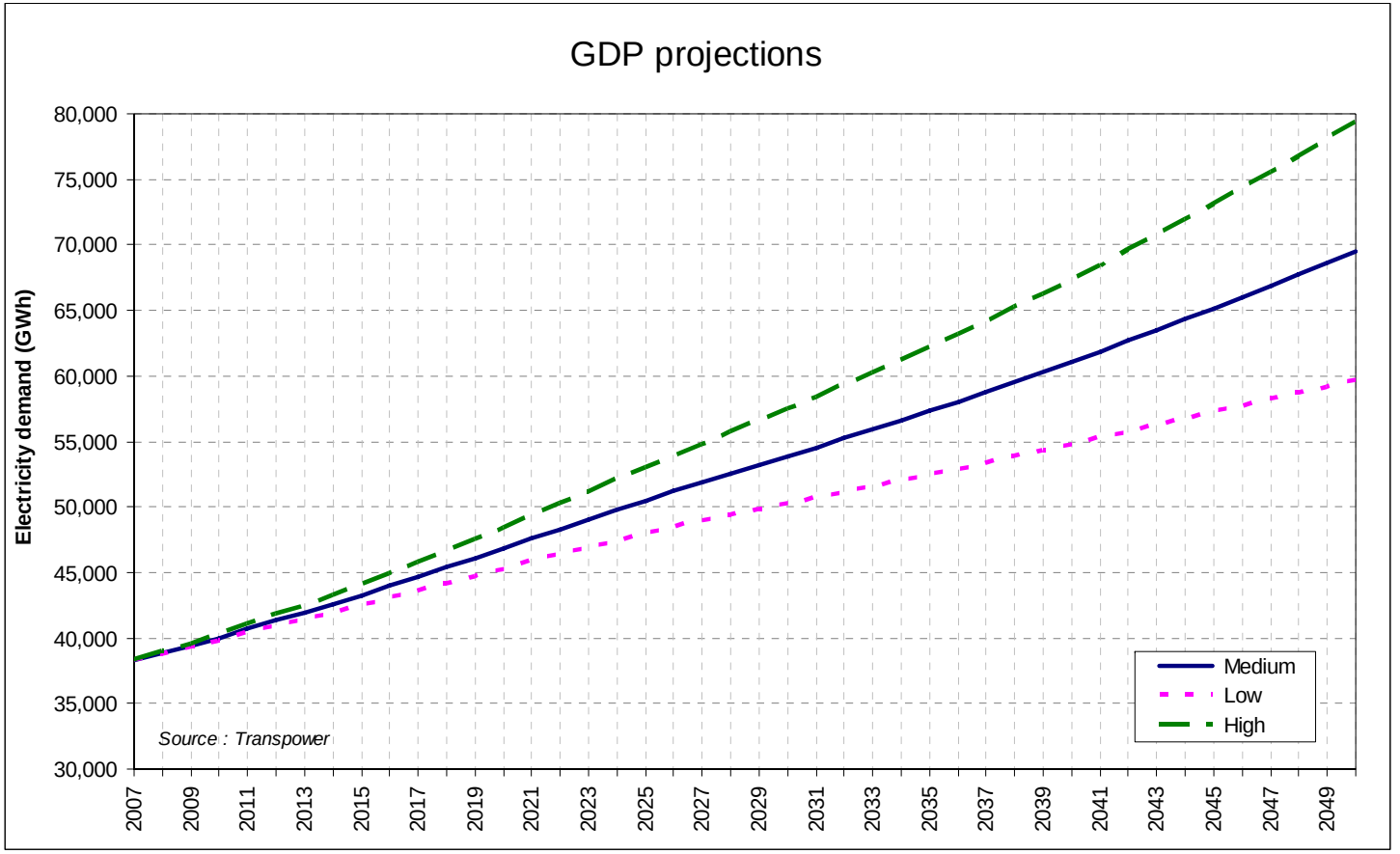


Scenario assumptions

Demand model



Example: GDP impact



Demand in the scenarios

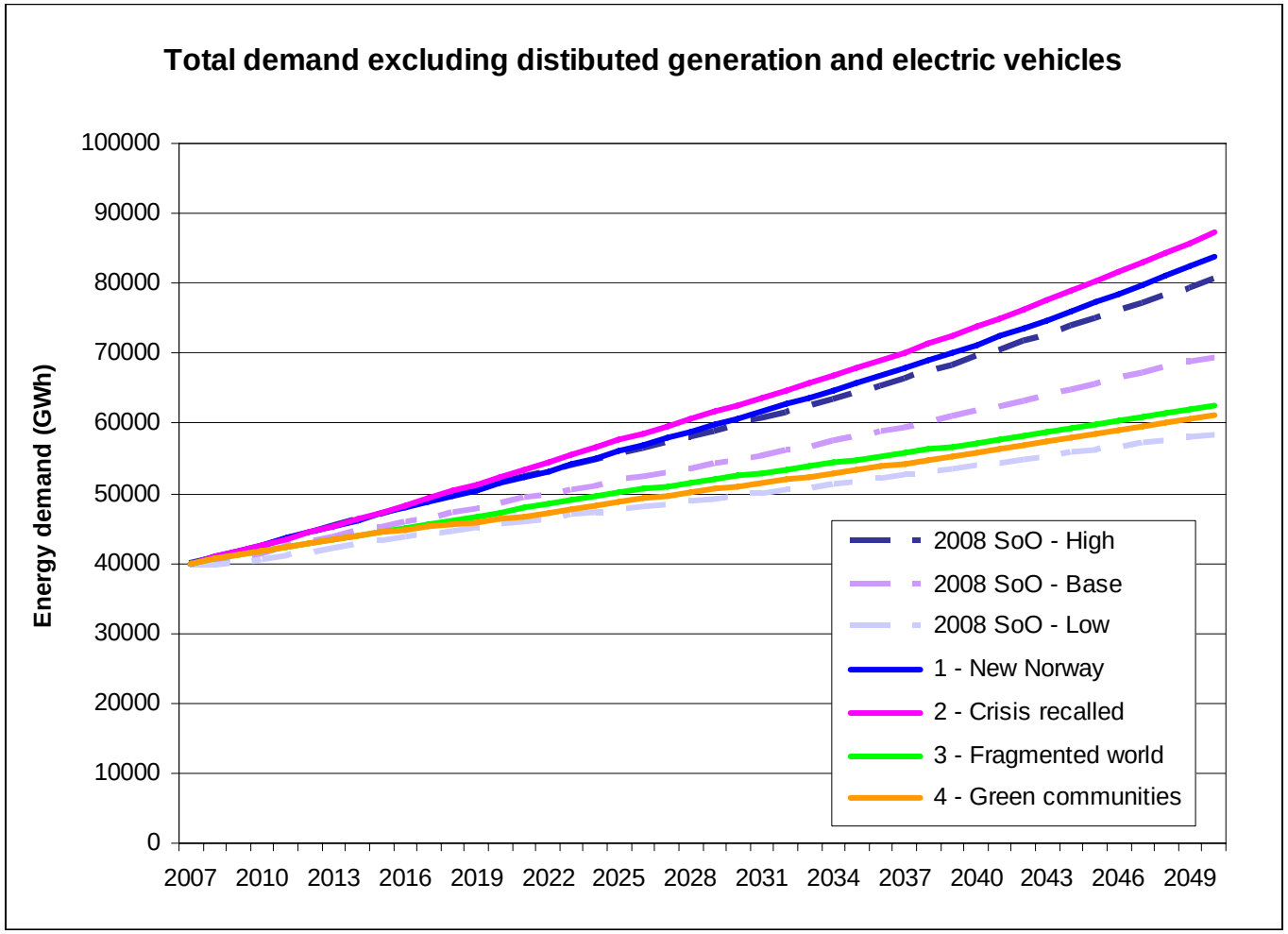
- Base assumptions

Scenario	Demand drivers				
	Population	GDP	Energy intensity	Price	HDD
1 - New Norway	High	High	Low+	High	Lower
2 - Crisis recalled	Base	Very high	Base	Low	Level
3 - Fragmented world	Low	Low	Base	Base	Lower
4 - Green communities	Base	Low	Low	High	Lower

- Fuel switching (TWh adjustments)

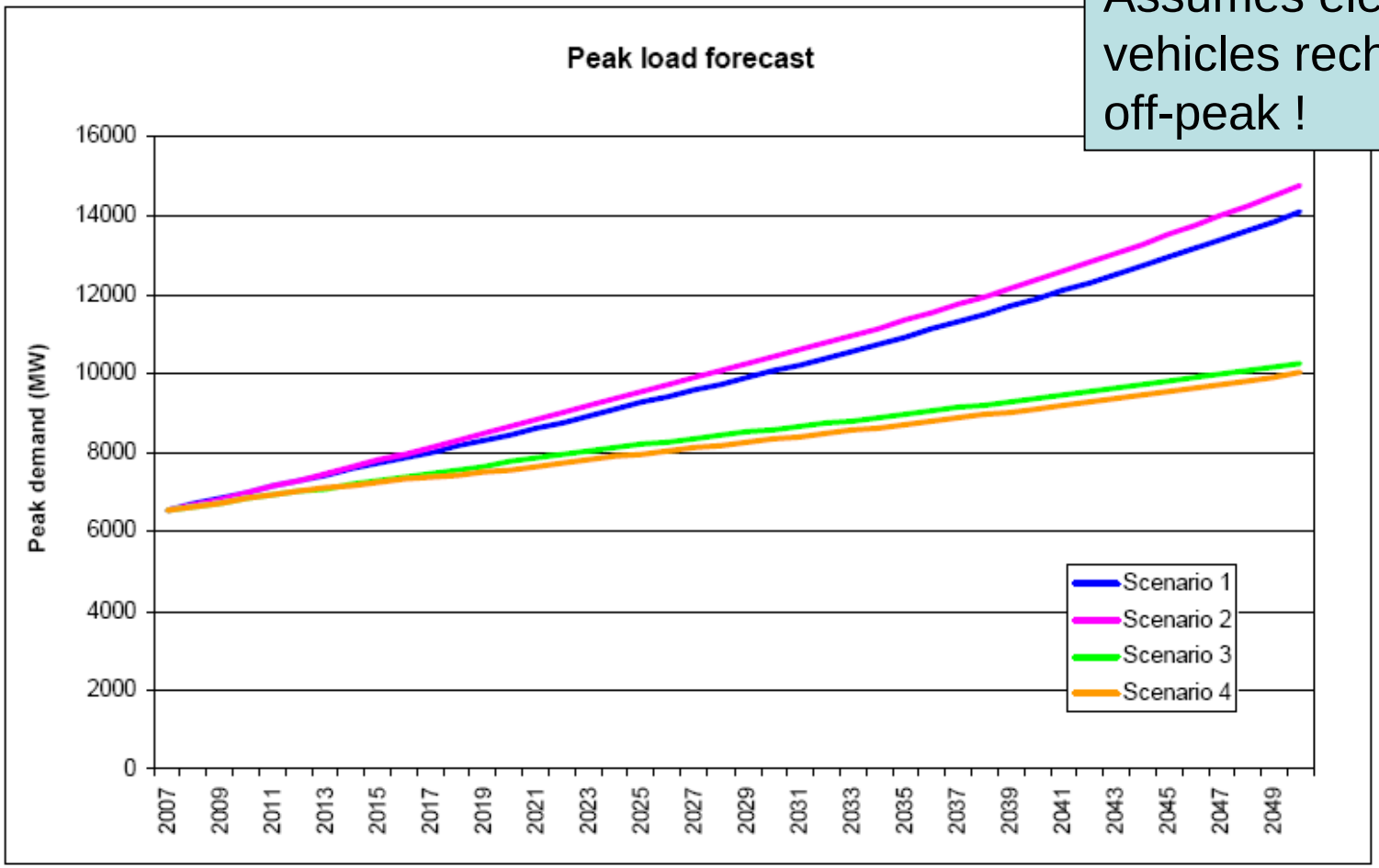
Scenario	Residential		Industry	Transport	
	Hot water heating	Space heating	Heating	Electric vehicles	Public transport
1 - New Norway	-0.5	1.5	4.0	5.5	0.0
2 - Crisis recalled	0.0	0.5	0.0	2.7	0.0
3 - Fragmented world	-0.5	0.0	0.0	2.7	0.0
4 - Green communities	-1.0	0.0	1.0	2.7	0.3

Resulting energy demand



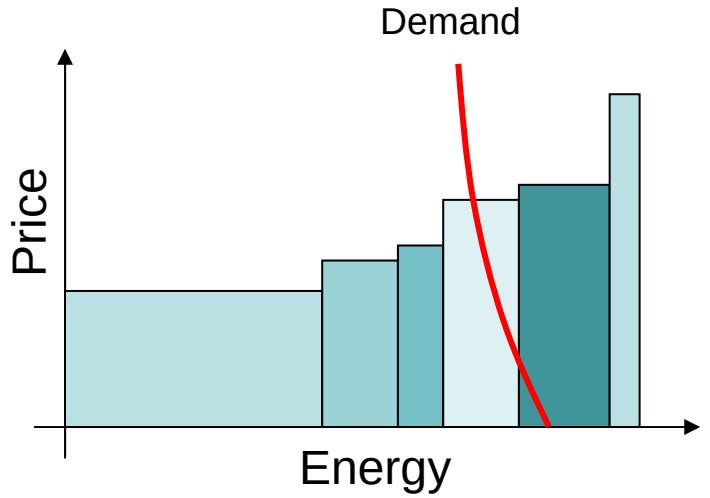
Resulting peak demand

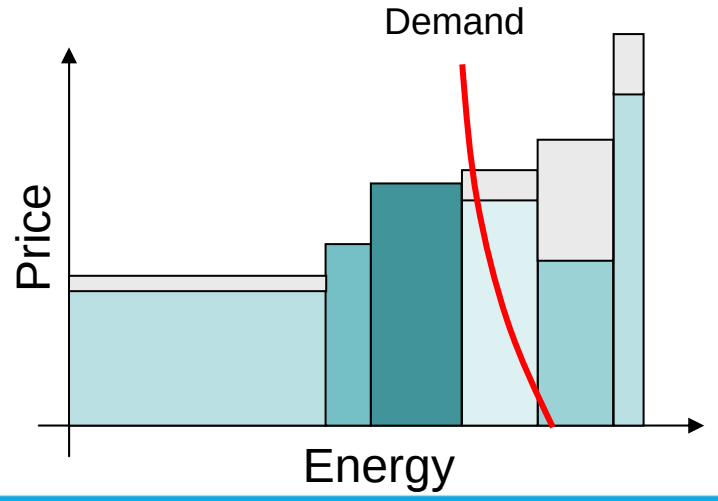
Assumes electric vehicles recharge off-peak !



Meeting demand – the supply side

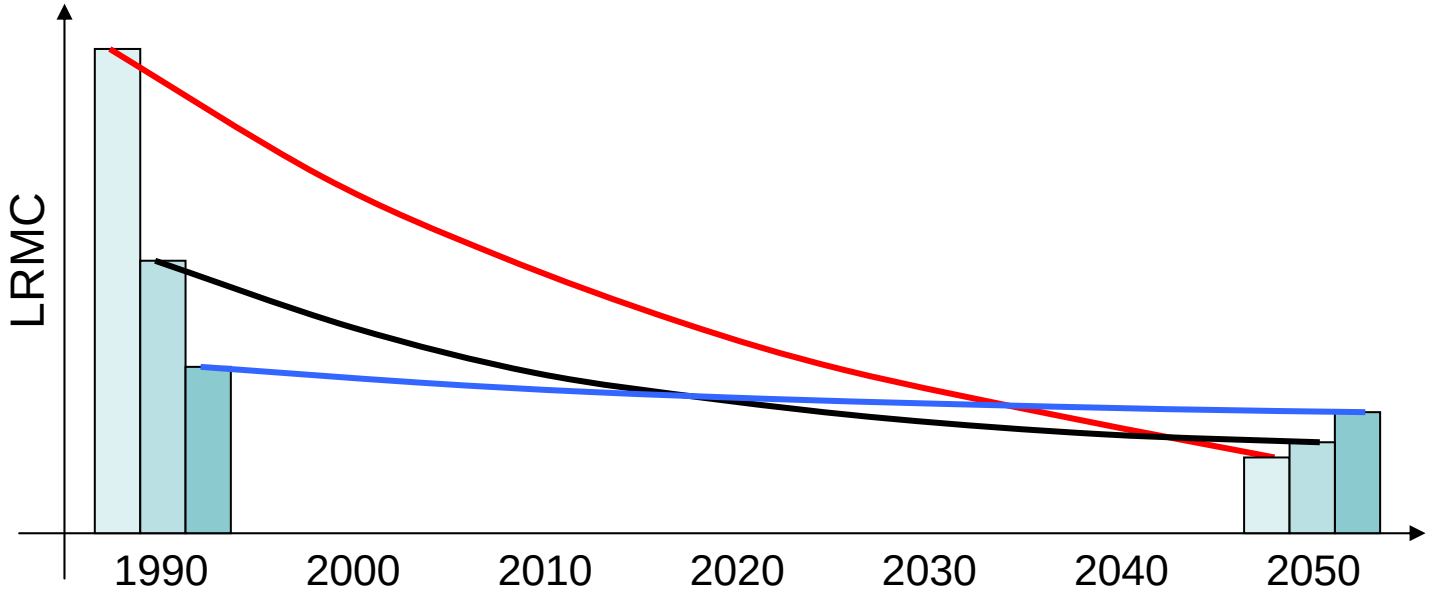
- Electricity demand has to be met by generation, either:
  - Large, grid-connected generation
  - Smaller, distributed generation (DG) embedded behind GXPs
- Large generation assumed to be cost driven (i.e. based on lowest LRMC) while DG projections are given per scenario.





Technological improvements

- Starting assumptions for generation projects as in 2008 Statement of Opportunities
- Assumption that technology cost will come down based on learning curves as shown conceptually below

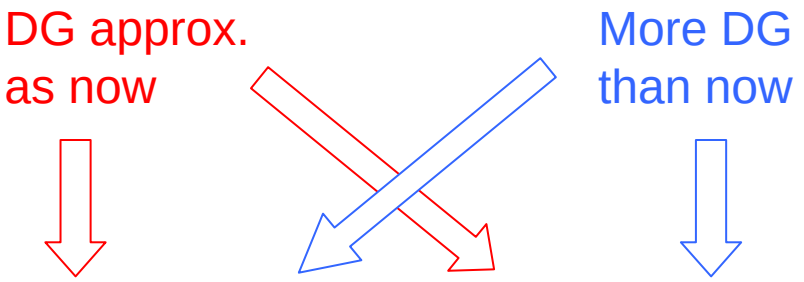


Supply side assumptions

Scenario	Supply side drivers				
	Crude oil price *US$/bbl*	**NZ gas price** *NZ$/GJ*	**Carbon price** *NZ$/tonne*	**Exchange rate** *US$:NZ$*	**Tech. change**
1 - New Norway	150	13.5	80	0.8	Wind - Wave -
2 - Crisis recalled	60	10	~0	0.6	Wind + Tidal -
3 - Fragmented world	80	12	40	0.6	CCS – Hydro -
4 – Green communities	80	14	80	0.6	Hydro + Wave +

Distributed generation

- The following types of distributed generation have been defined:
  - micro-cogeneration
  - solar photovoltaic panels
  - micro-hydro power
  - mini-hydro power
  - mini-wind power
- Scenario assumptions:



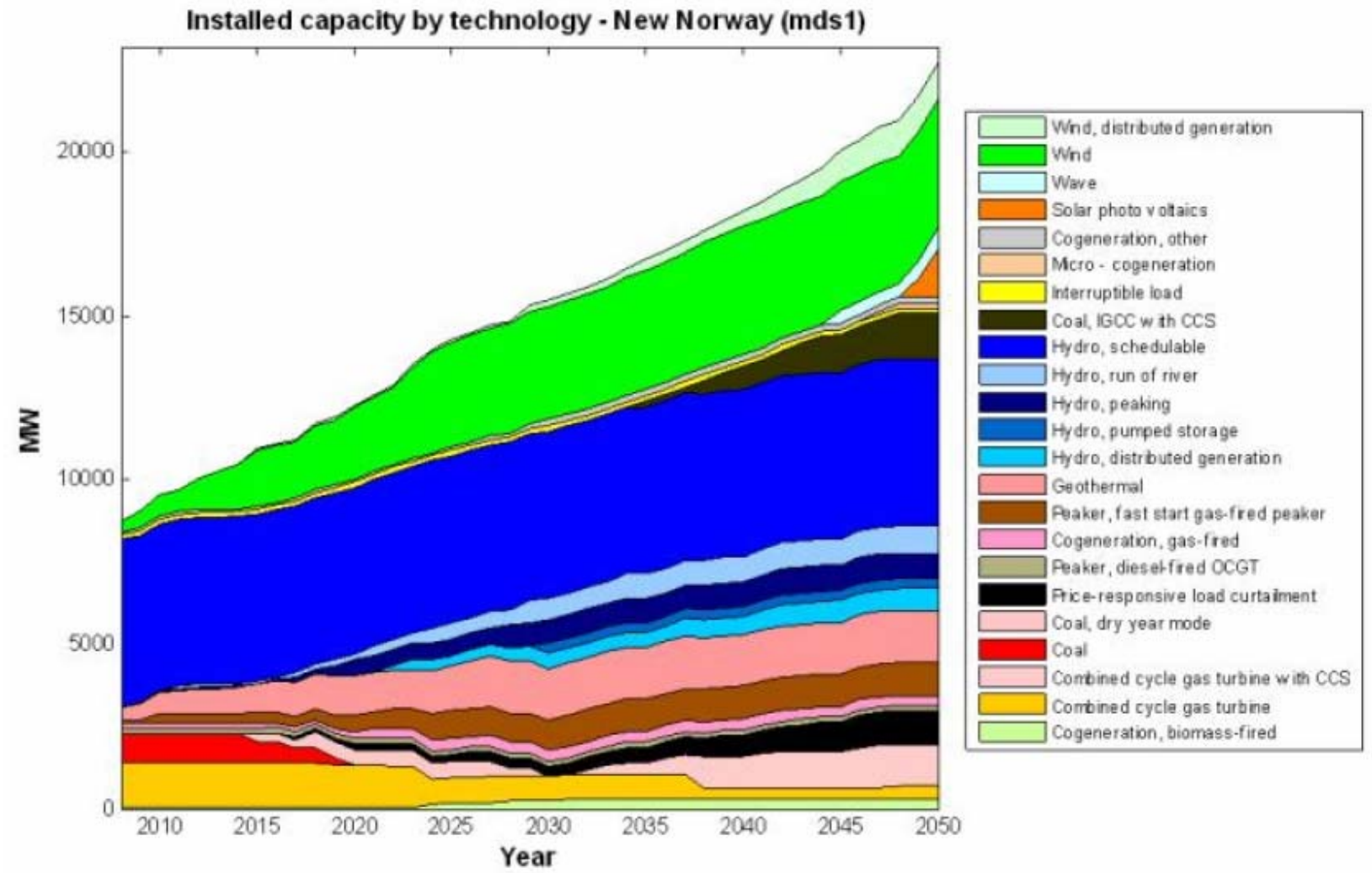
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Demand in GWh by 2050	89211	90021	65150	63833
Extra DG by 2050	2.5%	5.0%	2.5%	10.0%
DG - GWh now	1977	1977	1977	1977
DG - GWh extra by 2050	2230	4501	1629	6383
DG - GWh total by 2050	4207	6478	3606	8360

Quantification

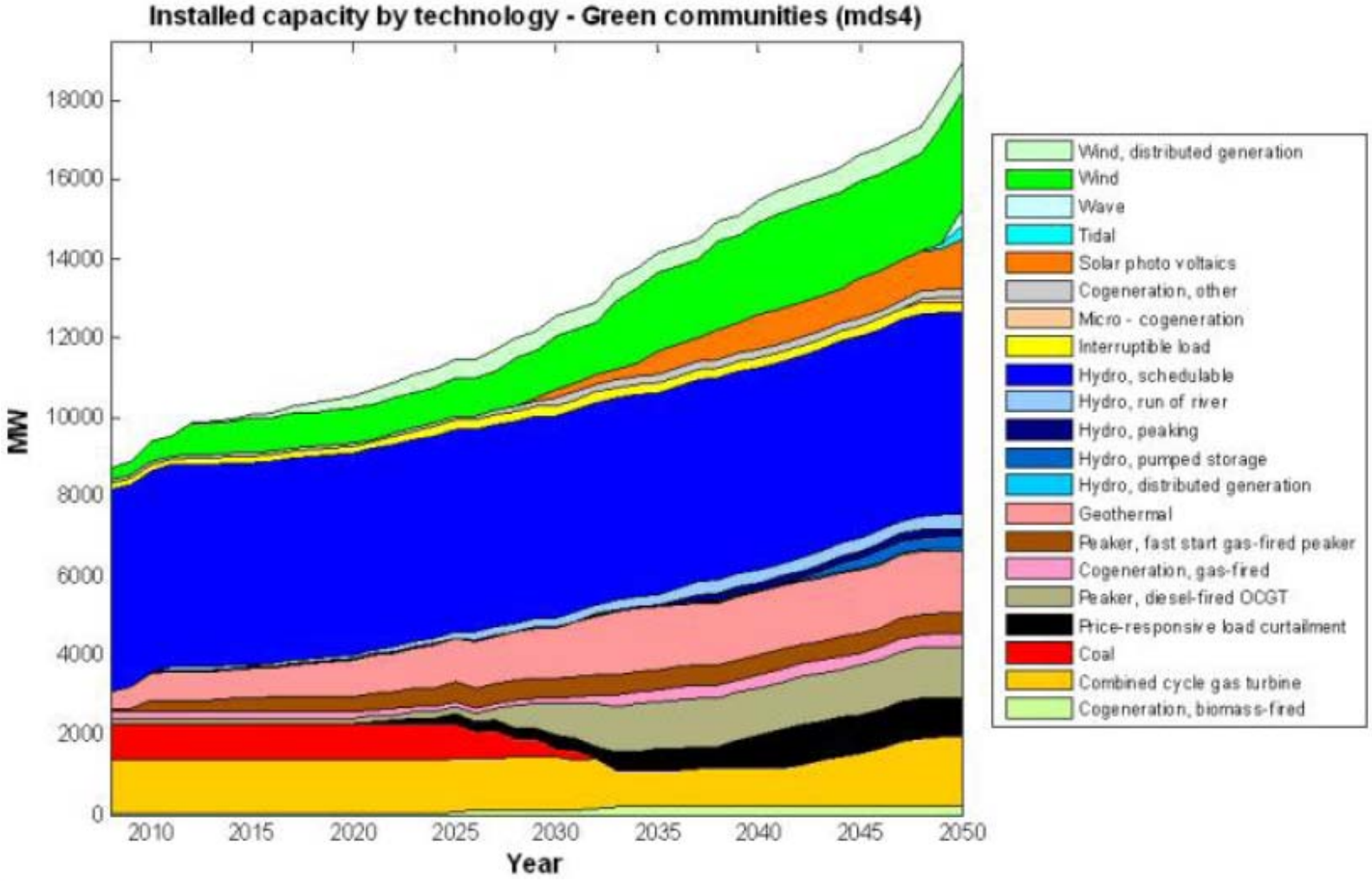
- Electricity Commission's GEM model used
- Will match demand with cheapest generation taking into account:
  - Fuel prices
  - Carbon prices
  - Technology costs

  while keeping enough reserves to cover loss of largest unit/HVDC pole

Generation built – scenario 1



Generation built – scenario 4



What is next?

- The work will be updated to the extent necessary, based on:
  - submissions due 14 November 2008
  - further meetings with stakeholders
  - review of documents published in November
- All numbers (demand and generation) will be finalized before Christmas
- The consultation document will be updated and published early next year

Some general questions

- Are the objectives of scenario study well defined?
- Is the approach taken reasonable?
- Are the created scenarios:
  - plausible,
  - consistent, and
  - relevant?
- What is the future of electricity in a low-carbon society?

Some specific questions

- Generation:
  - Technology trends / learning rates
  - Fuel and carbon prices
  - Feasibility of technologies, e.g. based on RMA issues/public opposition (hydro, wind, nuclear and carbon storage)
- Demand
  - Change in land use (dairy, irrigation, etc.)
  - Continue with urbanisation?
  - Fuel switching, drivers and responses
- Distributed generation
  - How much?
  - Impact on load duration curve?
- Load shaping
  - Future of demand response and energy storage technology