Modelling the Impact of Transmission Charging Options

TransmiT Decision Model demonstration

27th January 2011

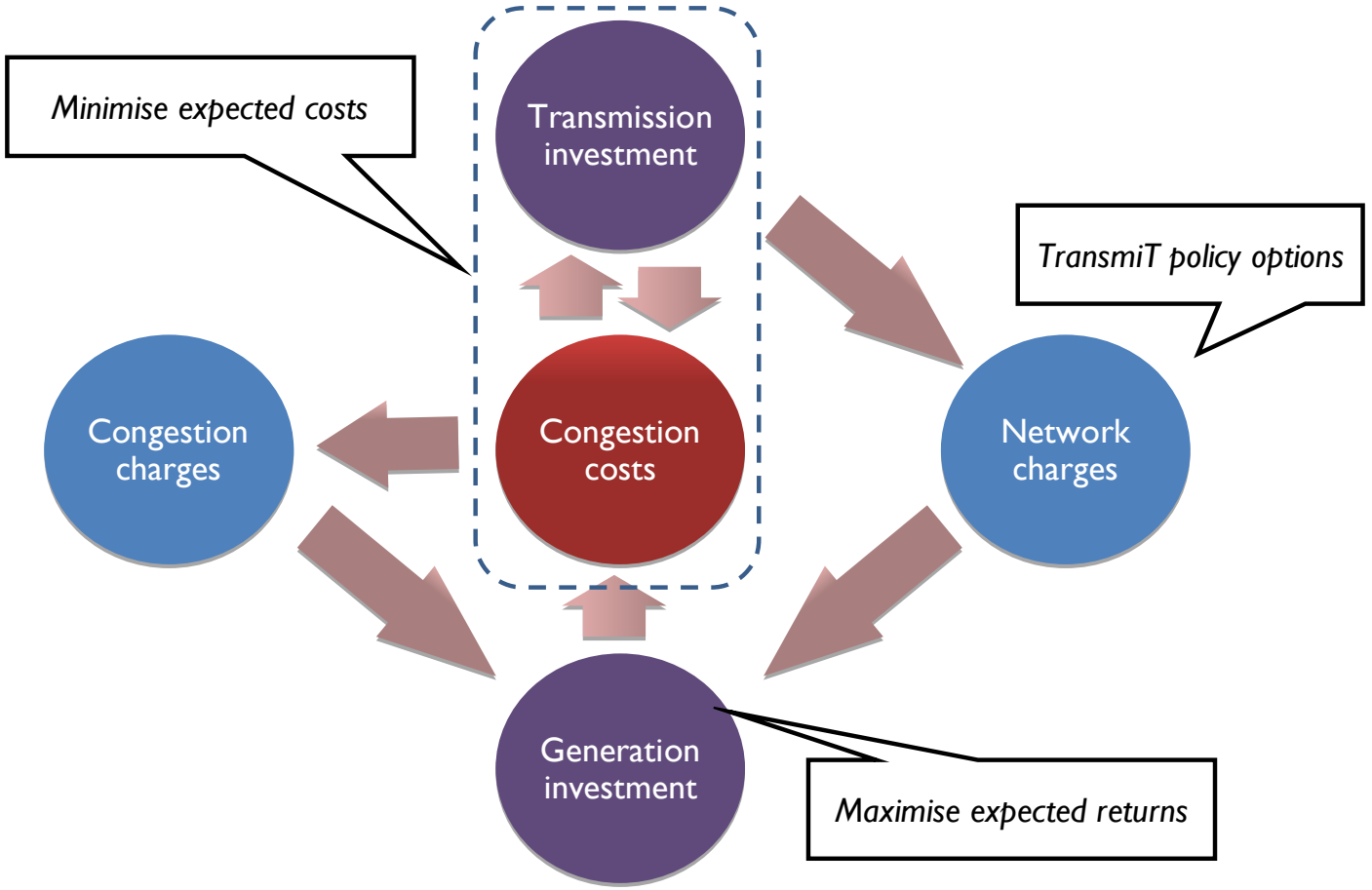
Date: 27 January 2012 **Client**: Ofgem

Agenda

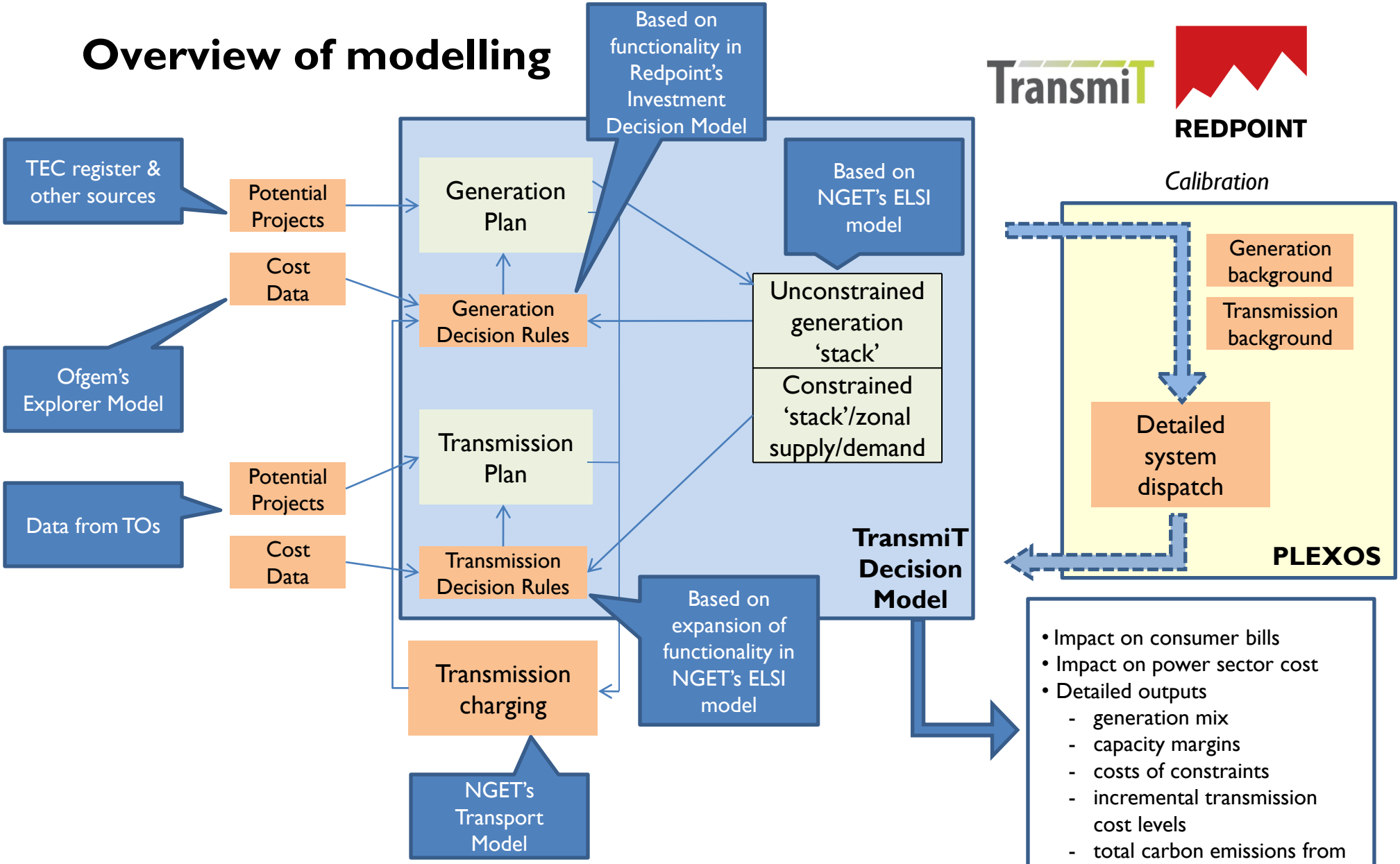
- Model overview
  - Schematic of model components
  - Discussion of the functionality of each component
  - Order of events in model run
- Key results: relationship to model components
- Demonstrations of model components
  - Transport Model
  - ELSI
  - Transmission investment
  - Generation investment
- Full model demonstration
- Summary
- Question & Answer session

Model overview

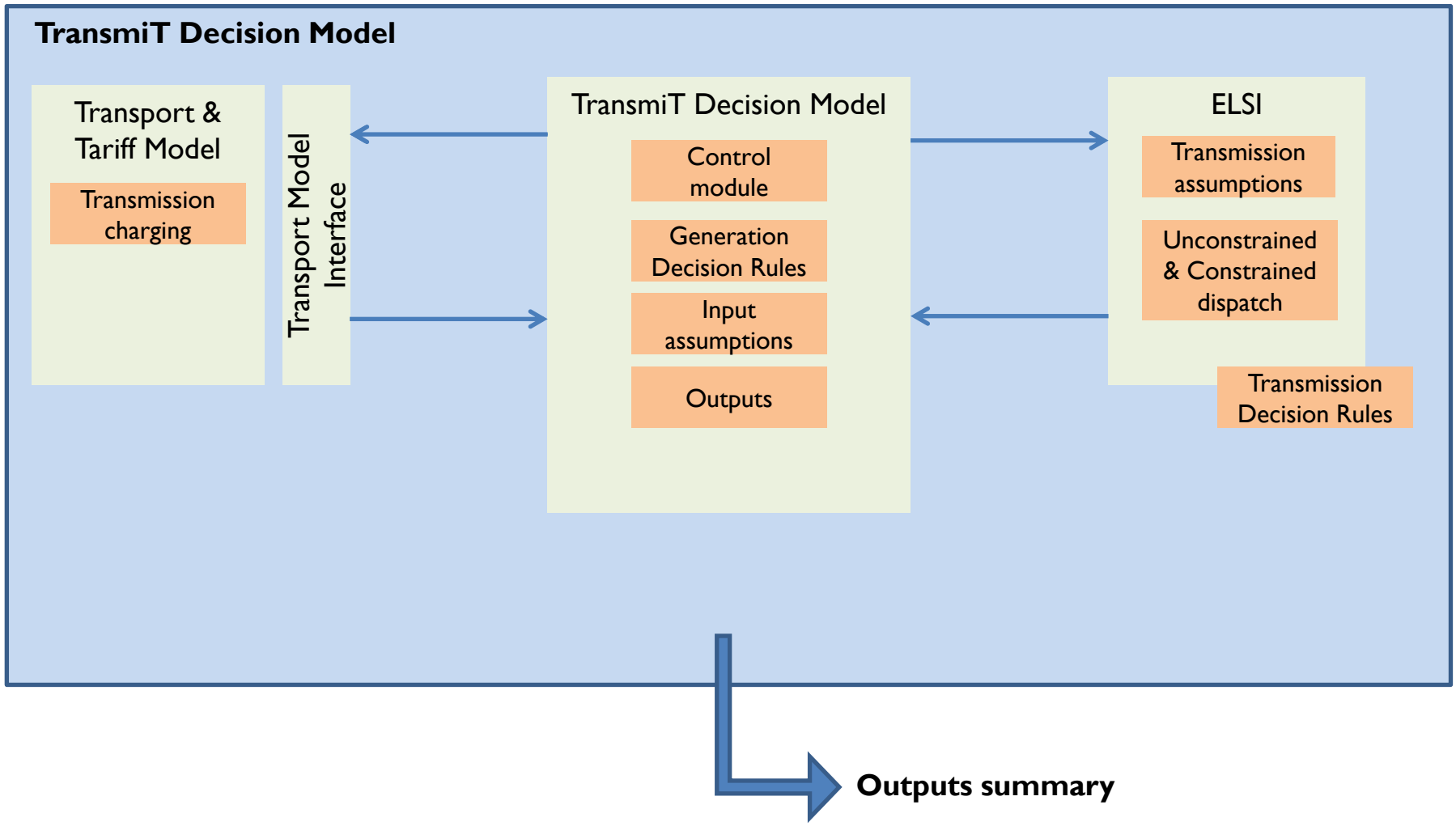
Conceptual framework



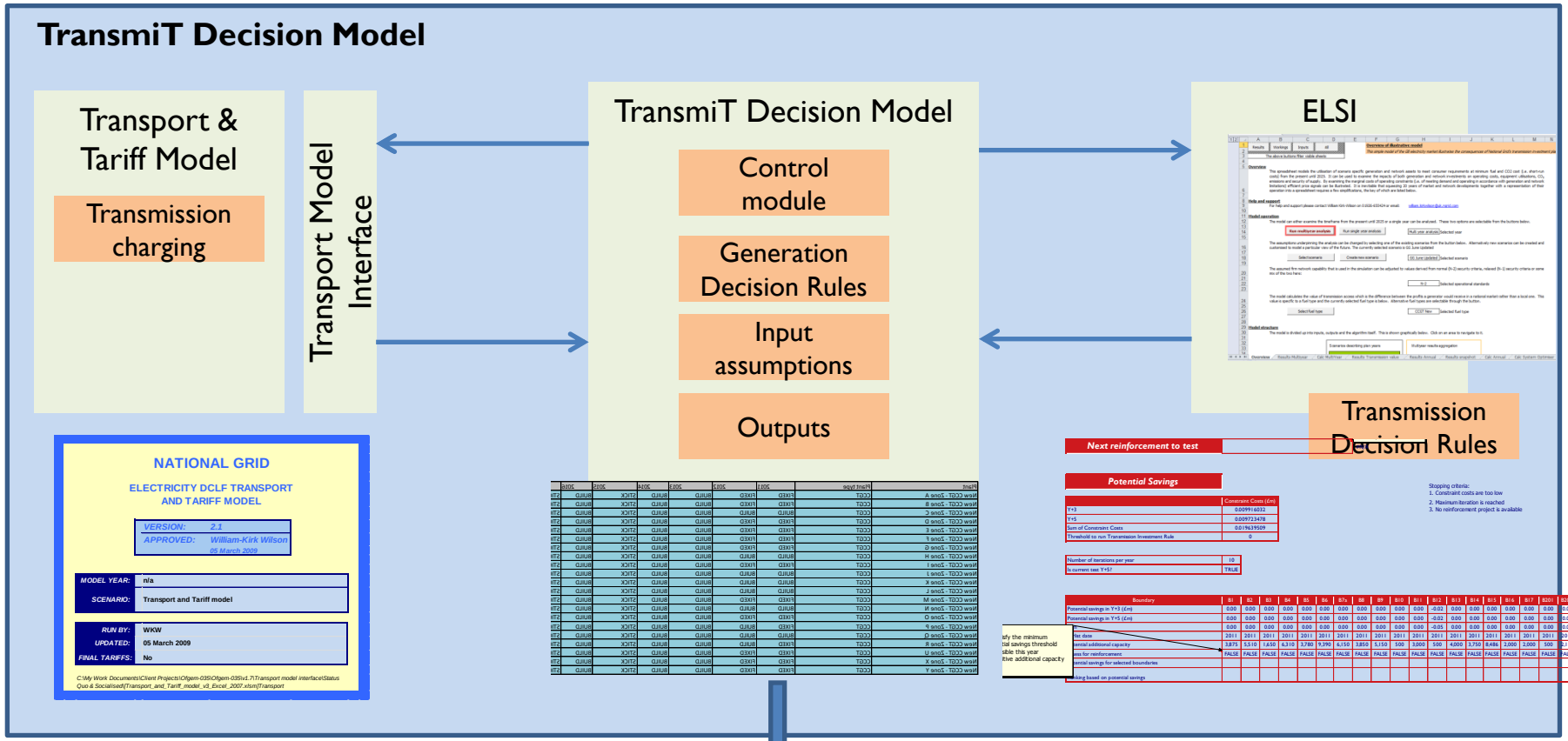
Overview of modelling



Model architecture

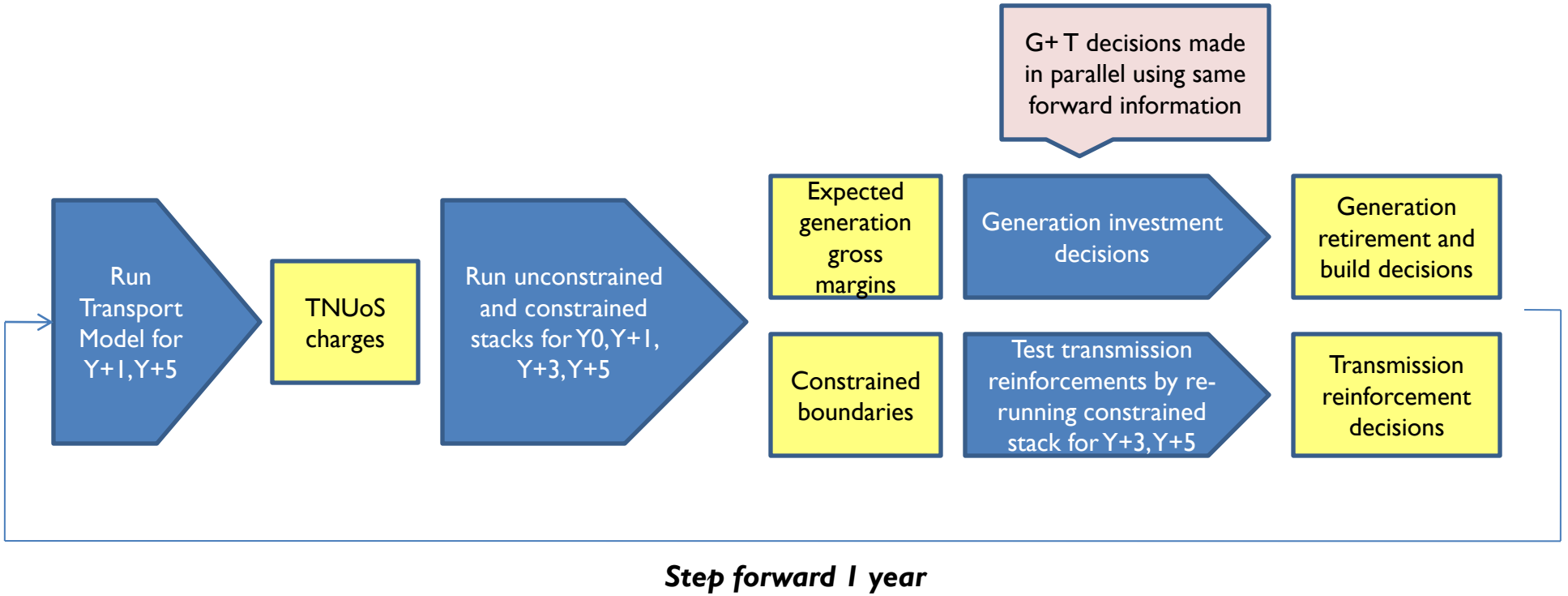


Model architecture



Simulation steps (non-perfect foresight)

An example of a simulation step assuming 5 year forward look ahead for decision making.



Breakdown of Cost Benefit Analysis

- Fuel and variable costs from dispatch in ELSI
- Capital and fixed costs set by capacity from Generation Decision Rules

- Transmission reinforcement from Transmission Decision Rules
- Transmission losses from ELSI

		Improved ICRP
		NPV 2011-2020
Benefit relative to Status Quo		
Power sector costs	Generation costs	313
	Transmission costs	-8
	Constraint costs	-171
	Carbon costs	-11
	Decrease in power sector costs	**122**

Dispatch in ELSI

Constraint costs form ELSI constrained dispatch

Cost Benefit Analysis: Improved ICRP

For reference during today's discussion

		Improved ICRP (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	313	965
	Transmission costs	-8	-418
	Constraint costs	-171	-1,089
	Carbon costs	-11	-2
	Decrease in power sector costs	**122**	**-543**
Consumer bills	Wholesale costs (inc. capacity payments)	-1,227	-182
	BSUoS	-85	-547
	Transmission losses	-123	-491
	Demand TNUoS charges	98	62
	Low carbon support	441	644
	Decrease in consumer bills	**-897**	**-512**

Cost Benefit Analysis: Socialised

For reference during today's discussion

		Socialised (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	453	1,803
	Transmission costs	-1,569	-7,873
	Constraint costs	-1,452	-4,535
	Carbon costs	-201	-218
	Decrease in power sector costs	**-2,769**	**-10,823**
Consumer Bills	Wholesale costs (inc. capacity payments)	-6,157	-6,843
	BSUoS	-723	-2,276
	Transmission losses	-553	-2,693
	Demand TNUoS charges	-849	-4,402
	Low carbon support	1,406	3,342
	Decrease in consumer bills	**-6,876**	**-12,873**

Demonstration of model components

Transport and Tariff Model

NATIONAL GRID

ELECTRICITY DCLF TRANSPORT AND TARIFF MODEL

VERSION:	*2.1*
APPROVED:	*William-Kirk Wilson*
	05 March 2009

MODEL YEAR:	n/a
SCENARIO:	Transport and Tariff model

RUN BY:	WKW
UPDATED:	05 March 2009
FINAL TARIFFS:	No

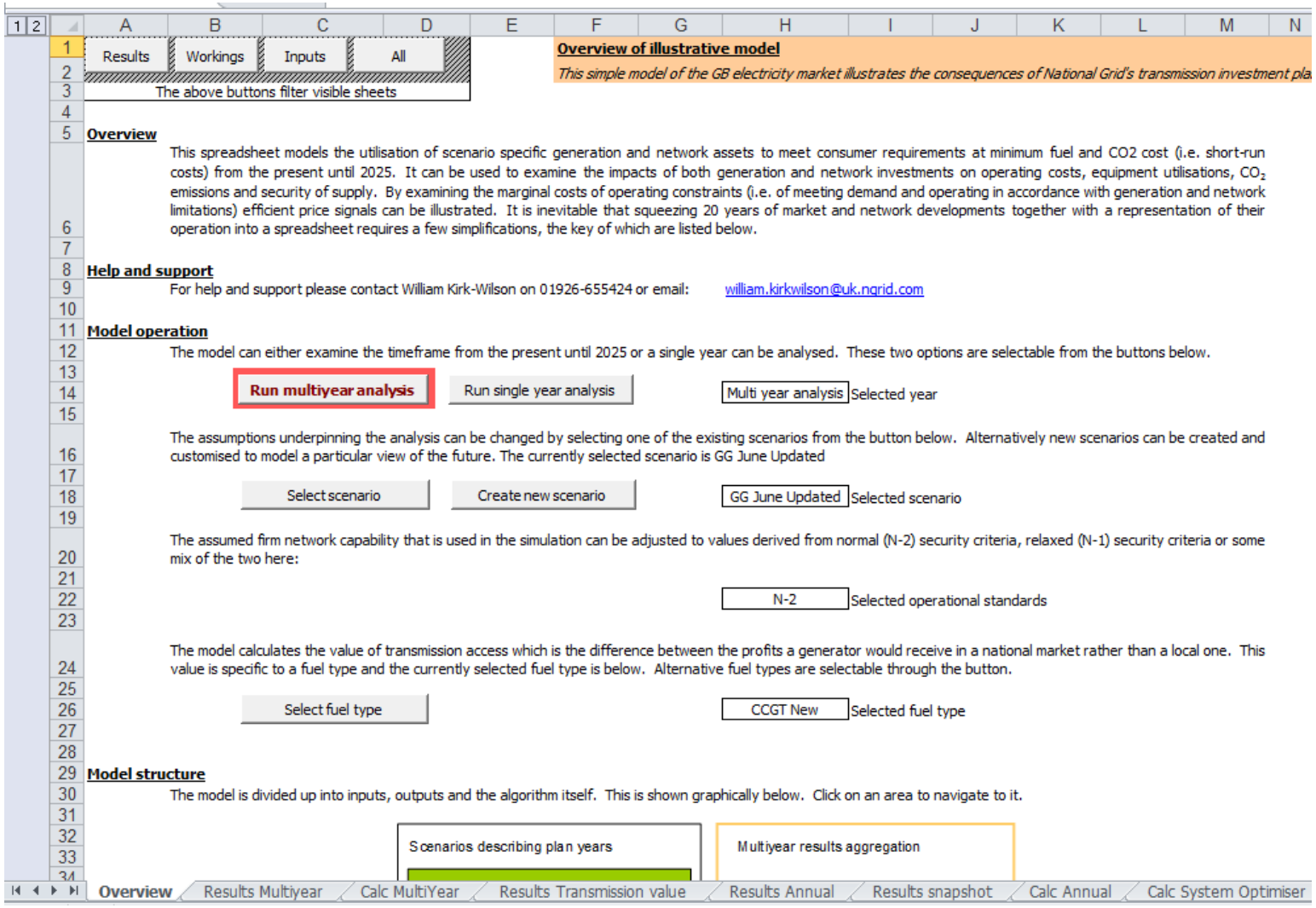
C:\My Work Documents\Client Projects\Ofgem-035\Ofgem-035\v1.7\Transport model interface\Status Quo & Socialised\[Transport_and_Tariff_model_v3_Excel_2007.xlsm]Transport

Transport model: Improved ICRP and Socialised

- Socialised charging is a simplification and does not require a transport model – tariffs are calculated directly in the Transport Model Interface

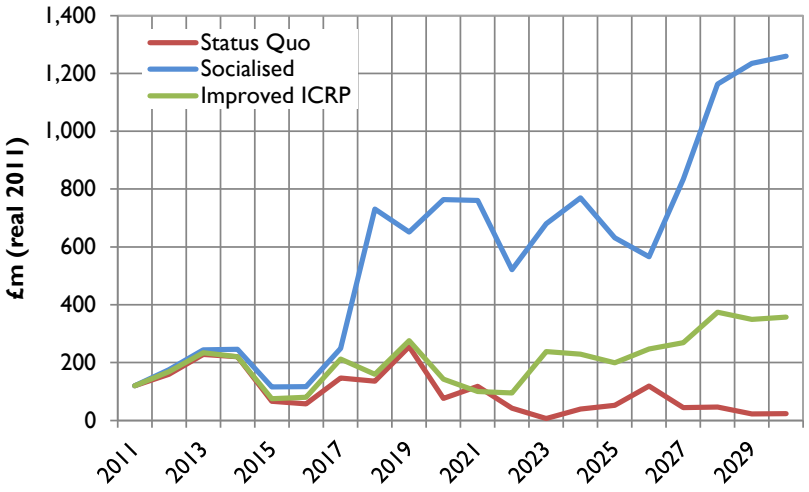
- Separate Transport model for Improved ICRP, which requires addition inputs of
  - Annual load factor by generator (calculated from previous 5 years of history)
  - Peak security factor by plant type (static)
- Improved ICRP zonal outputs have two parts to the wider tariff
  - Year round (CBA)
  - Peak Security

Electricity Scenario Illustrator (ELSI)

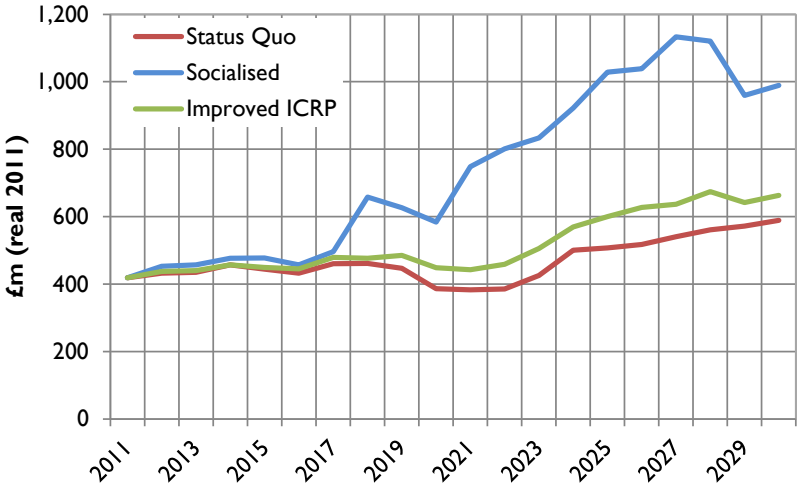


Electricity Scenario Illustrator (ELSI): results from ELSI

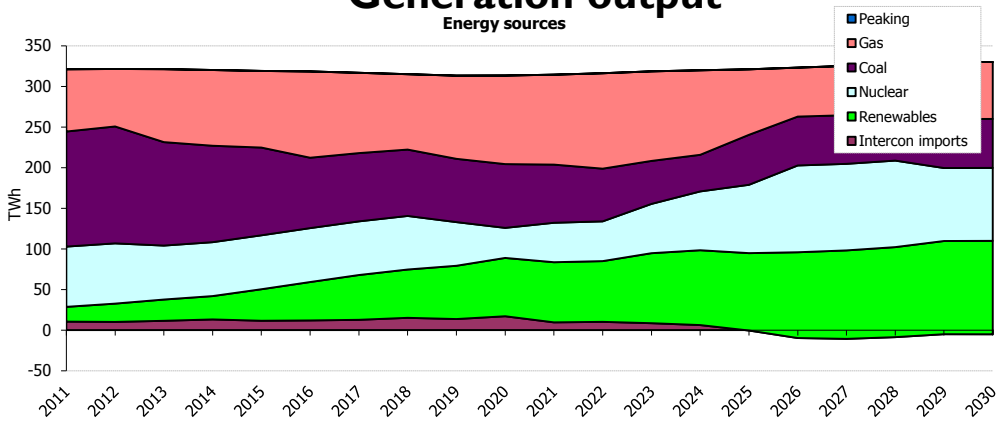
Annual constraint costs



Annual transmission losses



Generation output



Transmission Decision Rules

Next reinforcement to test		#N/A

Potential Savings

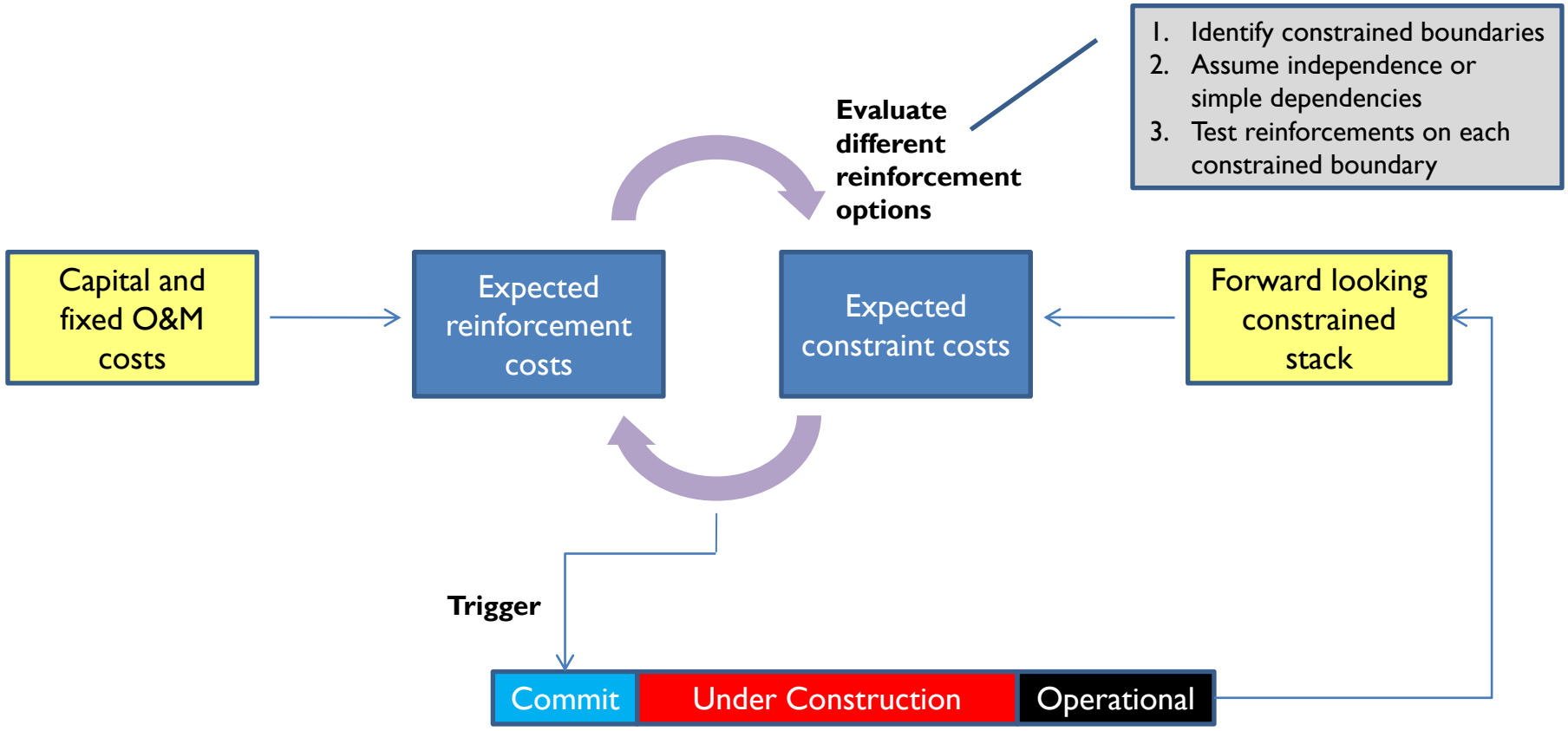
	Constraint Costs (£m)
Y+3	0.009916032
Y+5	0.009723478
Sum of Constraint Costs	0.019639509
Threshold to run Transmission Investment Rule	0

Number of iterations per year	10
Is current test Y+5?	TRUE

Stopping criteria:
1. Constraint costs are too low
2. Maximum iteration is reached
3. No reinforcement project is available

Boundary	B1	B2	B3	B4	B5	B6	B7a	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B201	B202	EC5	NW2
Potential savings in Y+3 (£m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential savings in Y+5 (£m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]list date	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
[illegible]tential additional capacity	3,875	5,510	1,650	6,310	3,780	9,390	6,150	3,850	5,150	500	3,000	500	4,000	3,750	8,486	2,000	2,000	500	2,157	6,314	5,953
[illegible]ess for reinforcement	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
[illegible]tential savings for selected boundaries																					
[illegible]anking based on potential savings																					

Transmission Decision Rules



Transmission Decision Rules

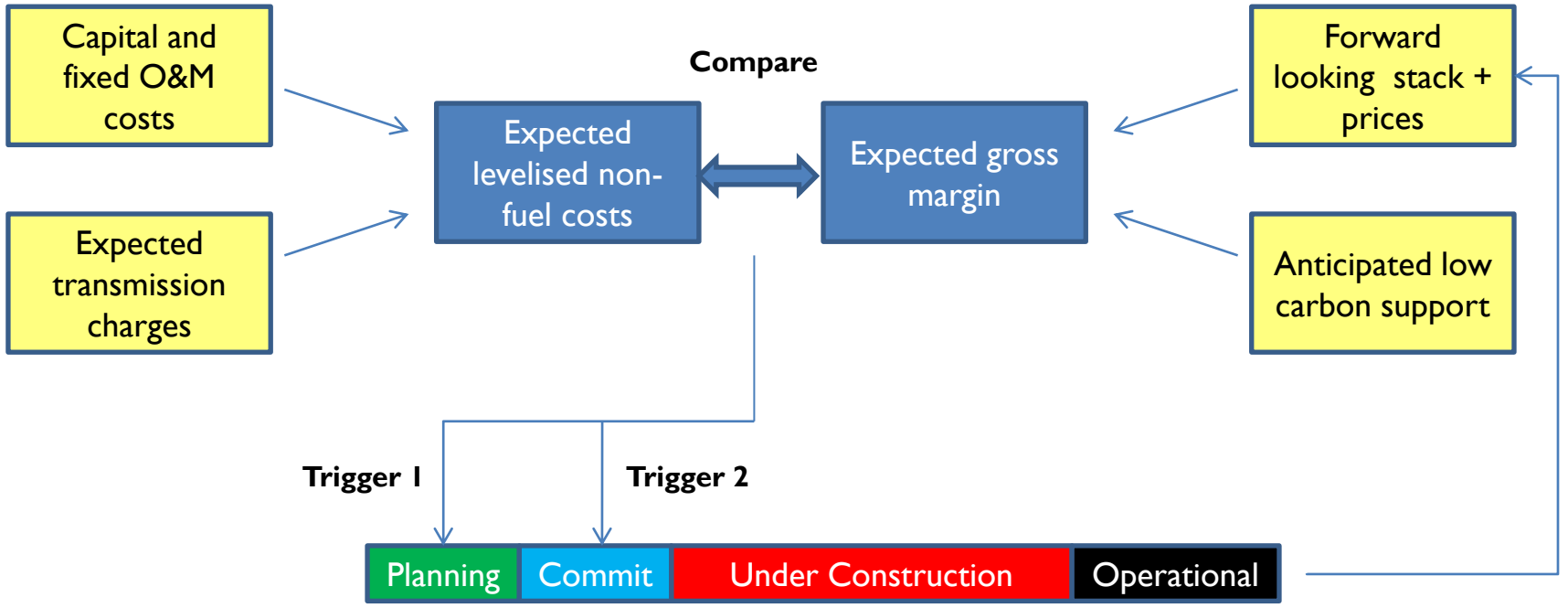
Timing of new HVDC links

Reinforcement	Capacity (MW)	Cost (£m, real 2011)	Boundaries reinforced	Assumed earliest feasible date	Status Quo	Socialised	Improved ICRP
Western HVDC Link	2000	866	B6, B7a	2015	2015	2015	2015
Western HVDC Link #2	2000	866	B6, B7a	2020	2023	2022	2020
Eastern HVDC Link	2000	891	B2, B4, B5, B6, B7a	2018	2022	2022	2018
Eastern HVDC Link #2	2000	891	B2, B4, B5, B6, B7a	2020	2027	2025	2024
Wylfa-Pembroke 2GW HVDC link	2000	834	B202, NW2	2018	-	-	-
Caithness - Moray HVDC	600	800	B1	2017	-	2022	2020
Humber - Walpole HVDC	2000	595	B8, B9, B11, B16	2020	-	2023	2027

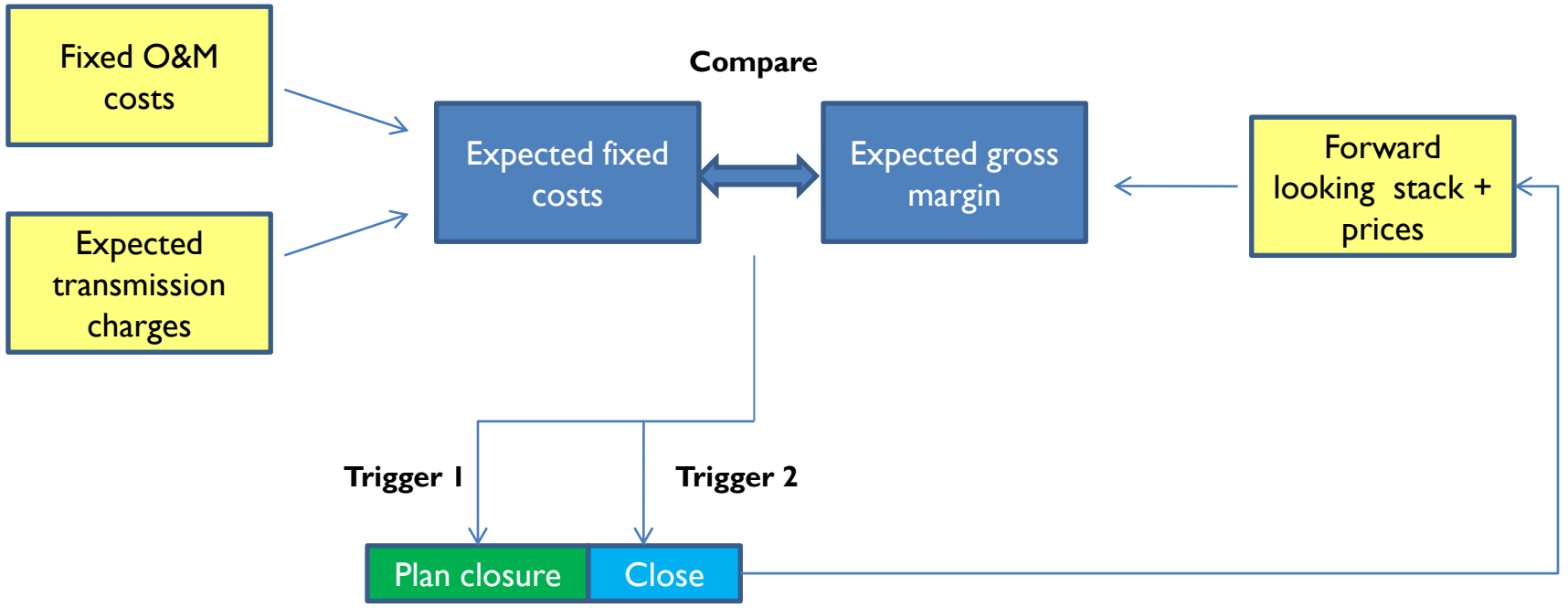
Generation Decision Rules

Plant	Plant type	2011	2012	2013	2014	2015	2016	
New CCGT - Zone A	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone B	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone C	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone D	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone E	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone F	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone G	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone H	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone I	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone J	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone K	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone L	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone M	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone N	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone O	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone P	CCGT	FIXED	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone Q	CCGT	BUILD	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone R	CCGT	FIXED	BUILD	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone U	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone X	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI
New CCGT - Zone Y	CCGT	FIXED	FIXED	BUILD	BUILD	STICK	BUILD	STI

Generation Decision Rules – New Build

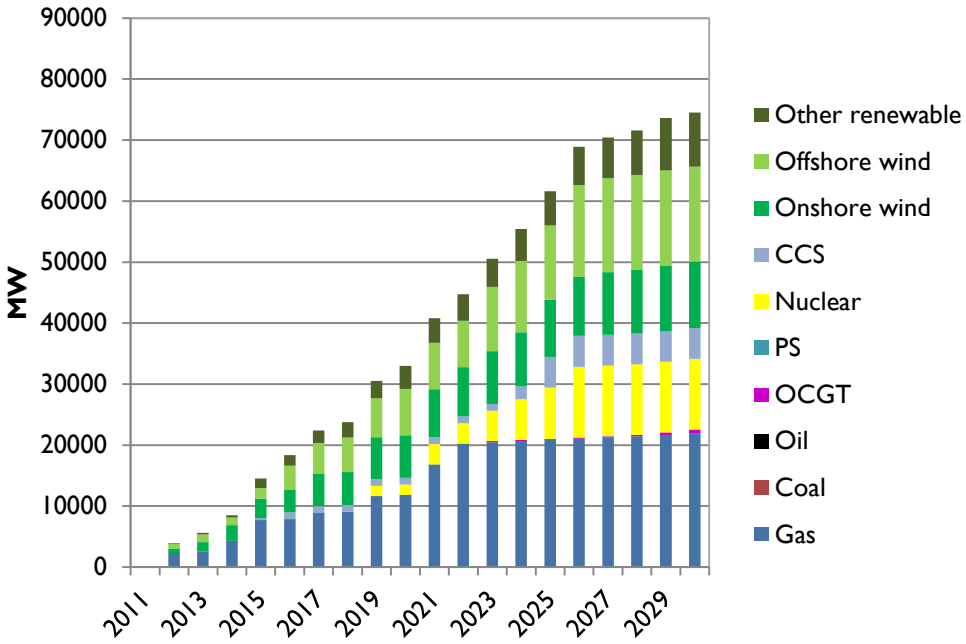


Generation Decision Rules – Retirements

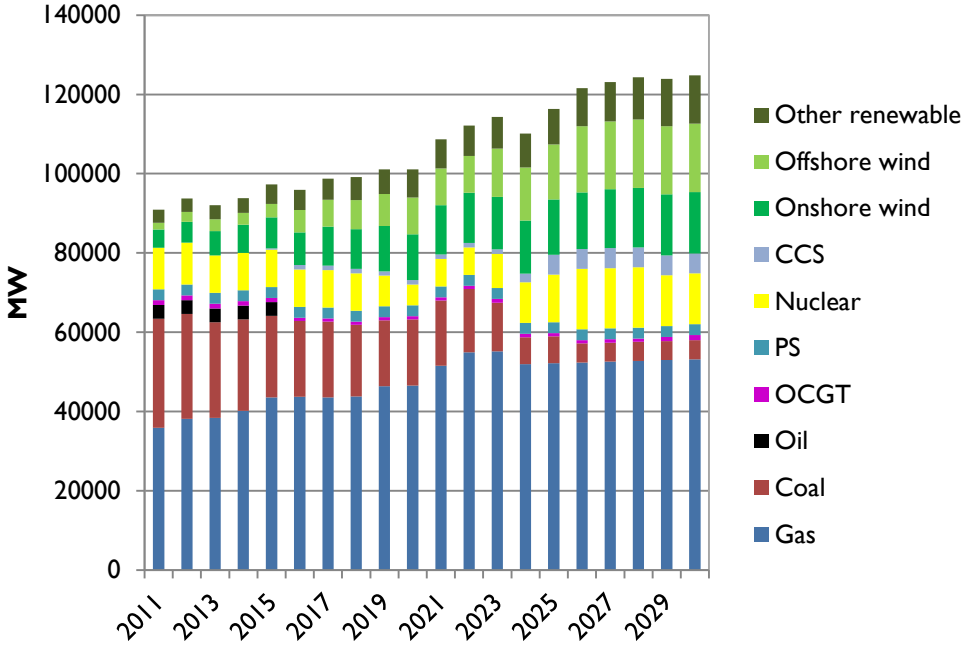


Generation Decision Rules

New build

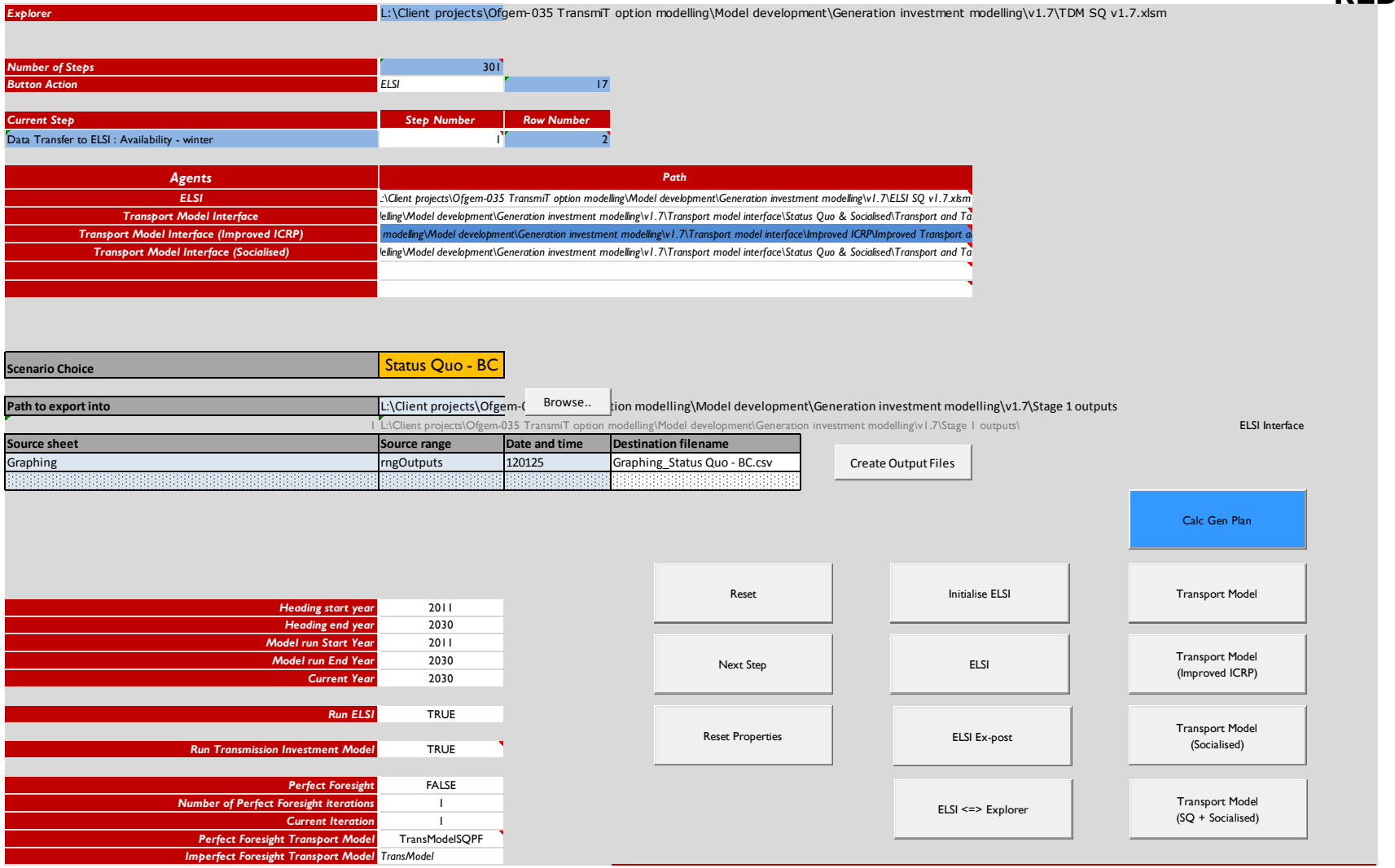


Capacity mix

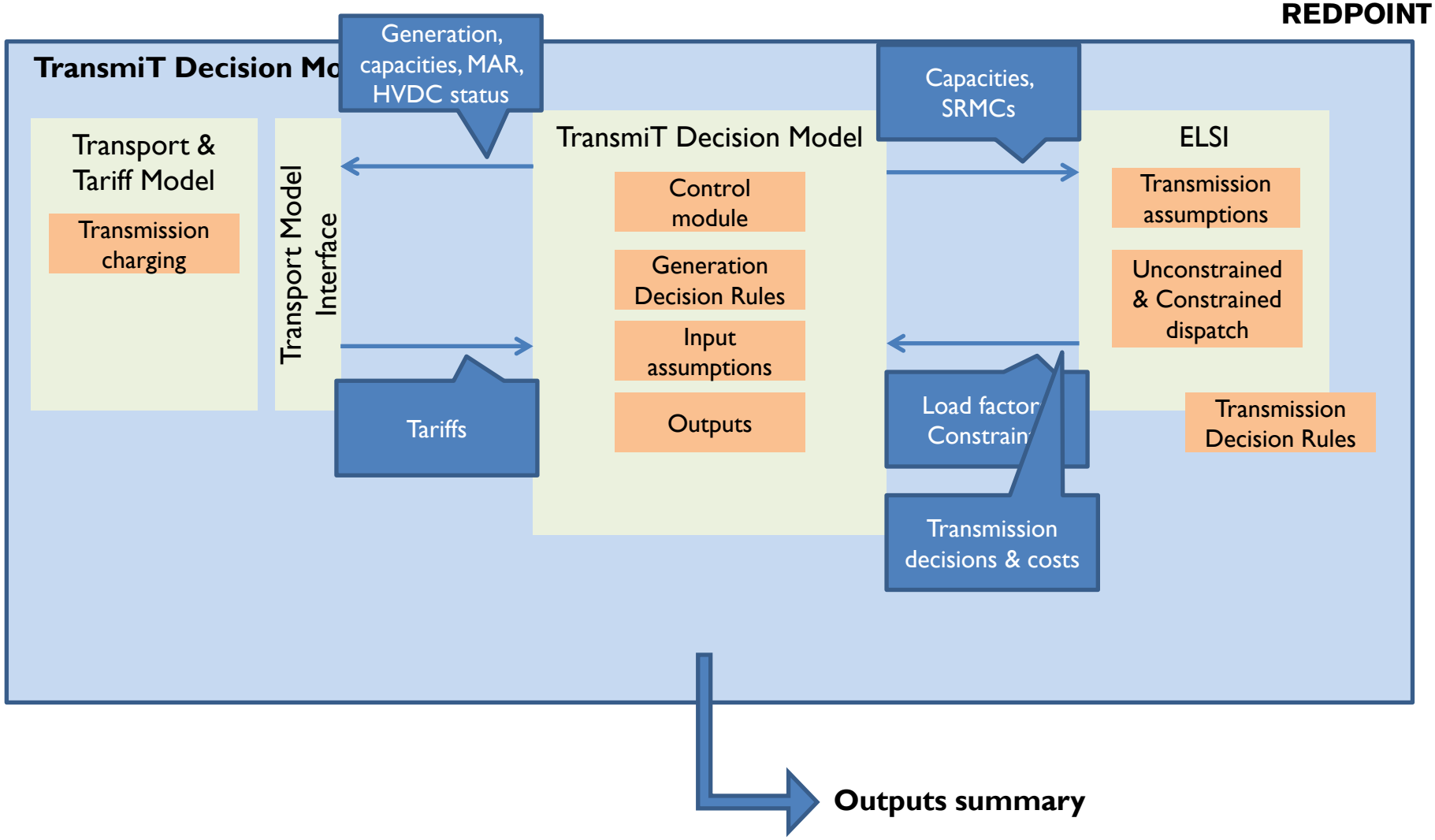


Full model demonstration

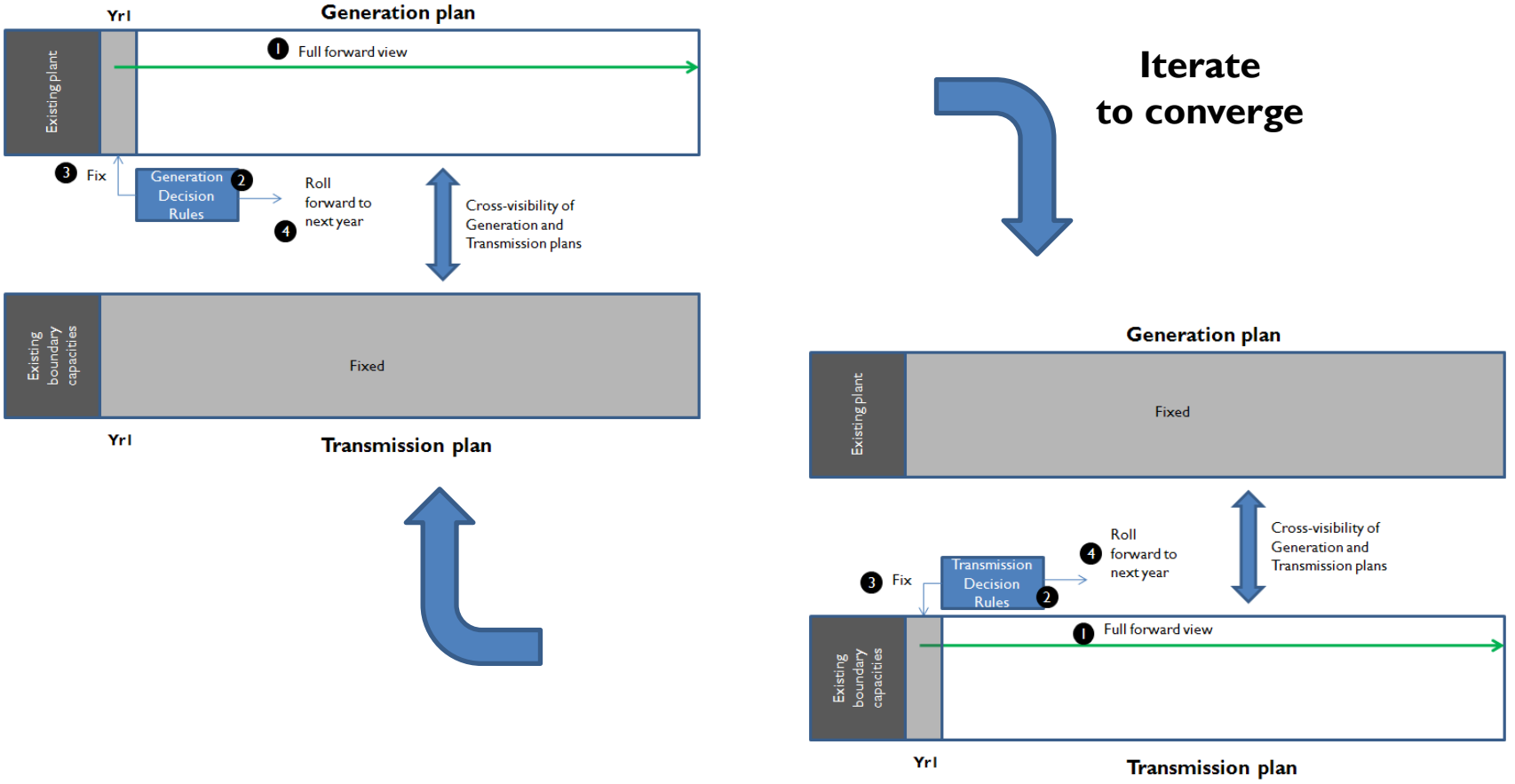
Full model demonstration



Full model demonstration

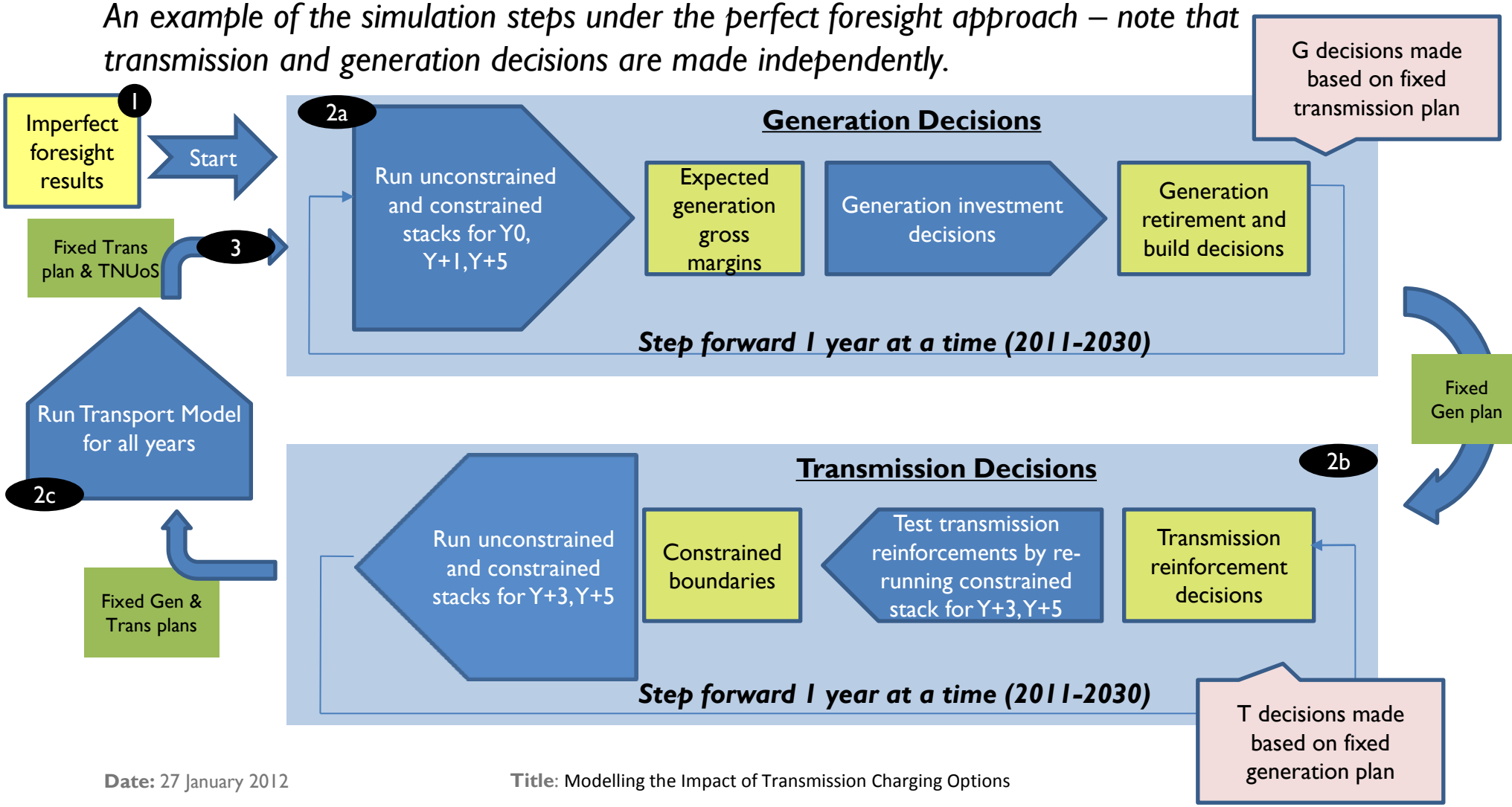


Perfect foresight - overview



Simulation steps (perfect foresight)

An example of the simulation steps under the perfect foresight approach – note that transmission and generation decisions are made independently.



ANY QUESTIONS?