nationalgrid

RfG Banding Thresholds – FES Scenario Data

Richard.Woodward@nationalgrid.com

Agenda

- Intro + Key Points
- Data Profiles:
  - Transmission System Demand
  - Distributed Generation
  - Sub 1MW Generation
  - Merit Orders for Response
- Next steps
- Back up data:
  - Transmission Generation

FES - Future Energy Scenarios

Distributed Generation – generation directly-connected to the Distribution network (also known as 'embedded generation')

Merit Order – the commercial viability of response providers

nationalgrid

Intro: RfG Banding

- GC0048 discussions on RfG banding have focused on reasonable expectations of Network Operators and Generators co-ordinating to manage the GB energy network
- The following data presents viable scenarios for system demand, generation, and response levels in the coming two decades, to illustrate how system management may change
- The data is not a forecast, but is a reasonable expectation based on inputs provided to NGET from external parties. It has also been consulted on with Transmission and Distribution System Owners
- It is hoped this data will provide a context for this workgroup agreeing where the GB banding thresholds should be set
- http://fes.nationalgrid.com/

nationalgrid

Intro: Future Energy Scenarios

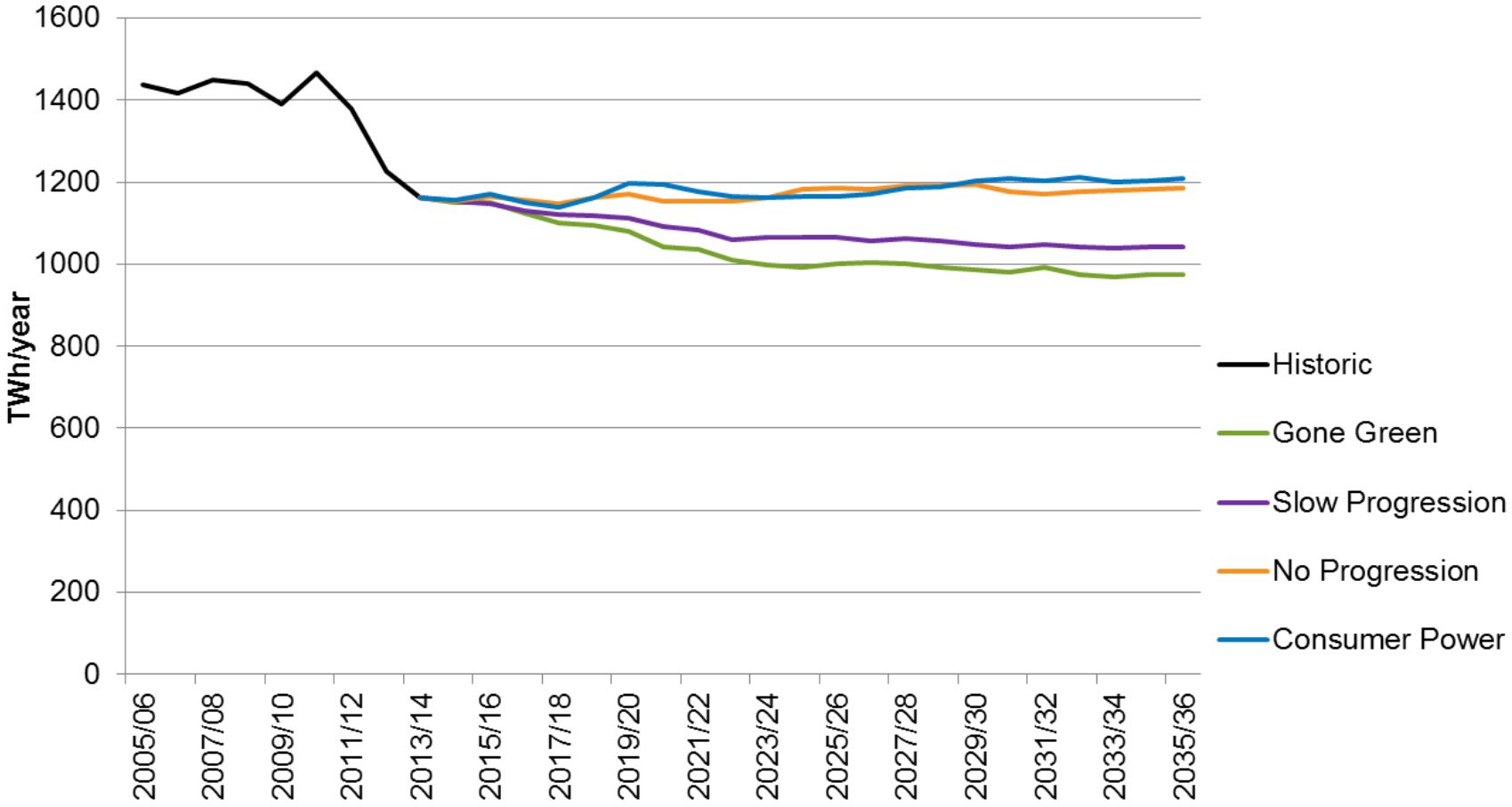
- **Gone Green** is a world where green ambition is not restrained by financial limitations. New technologies are introduced and embraced by society, enabling all carbon and renewable targets to be met on time
- **Slow Progression** is a world where slower economic growth restricts market conditions. Money that is available is spent focusing on low cost long-term solutions to achieve de-carbonisation, albeit it later than the target dates
- **No Progression** is a world focused on achieving security of supply at the lowest possible cost. With low economic growth, traditional sources of gas and electricity dominate, with little innovation affecting how we use energy
- **Consumer Power** is a world of relative wealth, fast paced research and development and spending. Innovation is focused on meeting the needs of consumers, who focus on improving their quality of life

Headlines

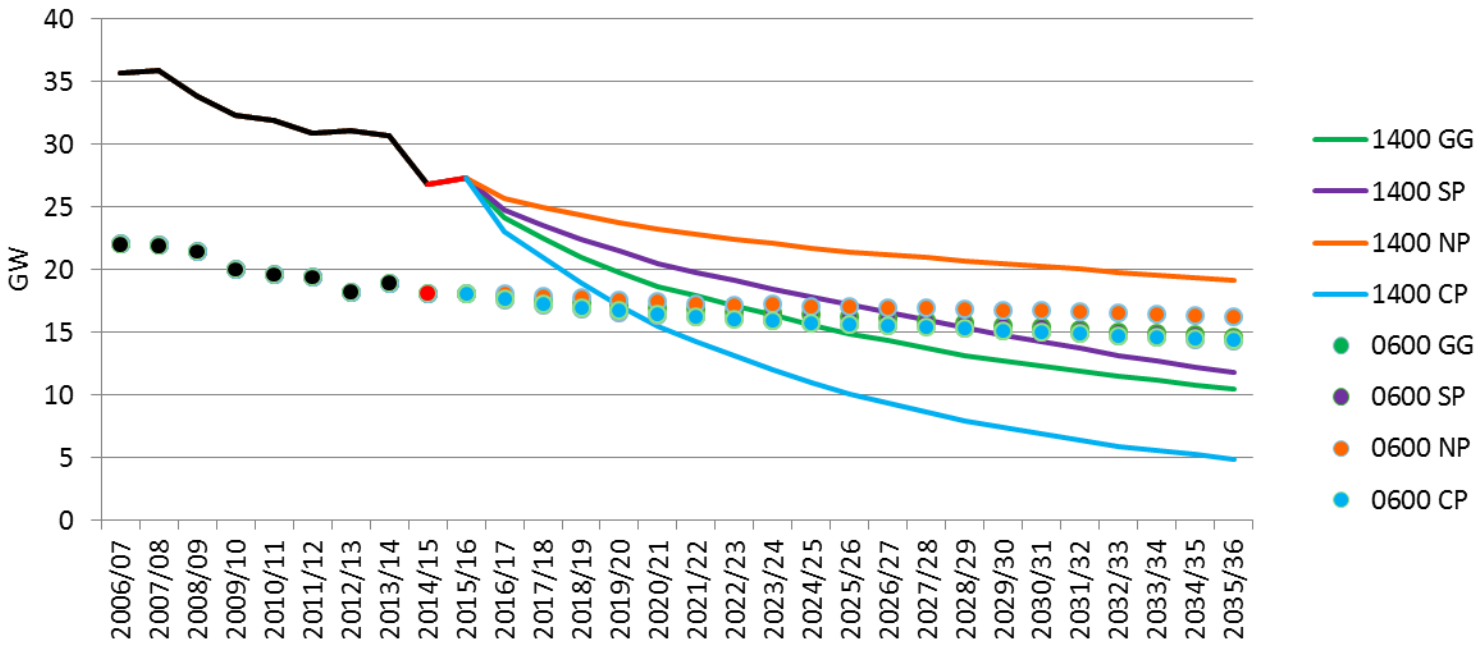
- Rapid growth of Distributed Generation (DG), a large proportion at Micro-Generation (sub 1MW) scale.
  - Primarily renewable technologies, at MG level high volumes of Solar PV
- Large volumes of intermittent DG lead to a significant reduction of system demand at summer minimum through export netting
  - 100% yield (not impossible) for solar, and higher wind outputs spikes, would give drastically different daily demand profiles
  - The Band A requirements do not mandate operational metering or instruction facilities other than curtailment.
- Frequency and voltage regulation across an uncertain demand/generation balance creates problems for the TSO
  - Traditional approaches to network containment in emergencies unlikely to work. The TSO would inevitably have to request DNOs to disconnect DG
- **RfG banding needs to consider levels of DG visibility and service availability, whilst markets need to evolve to support involvement of smaller players, aggregators, suppliers etc**

Demand

Annualised Transmission Demand



Transmission Demand – Summer Minimum



- Max/Min scenario delta at end of FES period (1400): 14.3 GW
- CP and GG scenarios introduce significant concern of future system stability, including availability of viable balancing providers and the need for DSR, or worst case, disconnection of DG

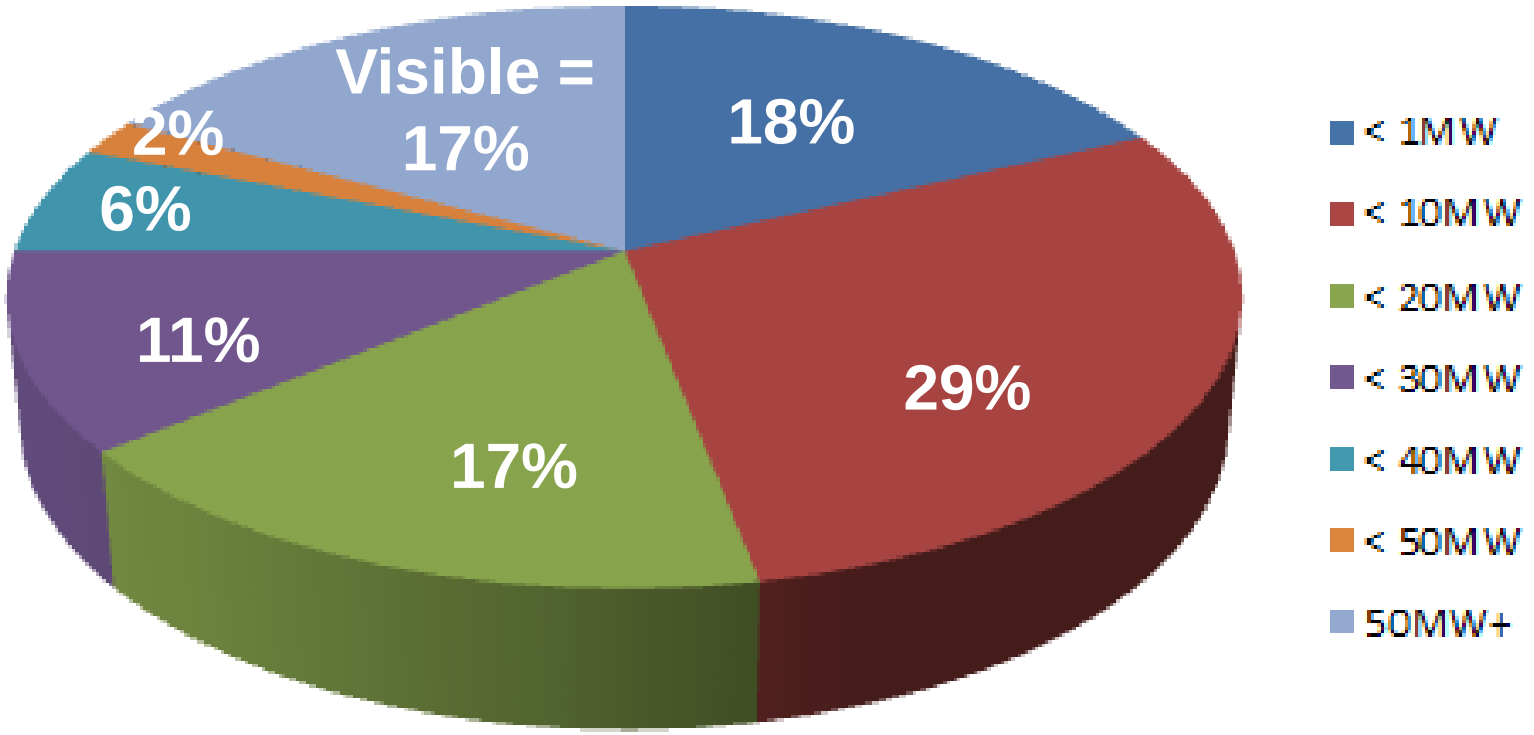
(Excludes interconnector export + generator own-use)

nationalgrid

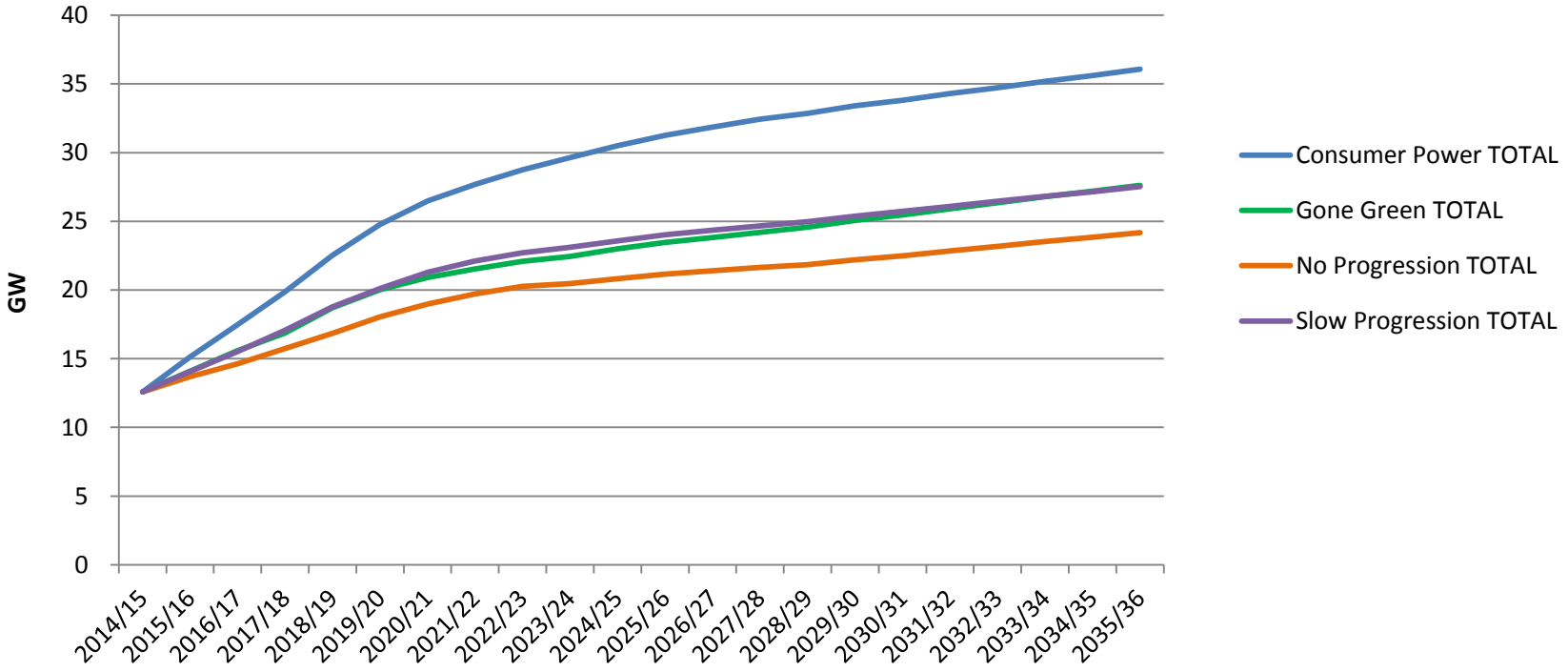
Distributed Generation

Current % Of Distributed Generation connected by size (Dec 2014)

nationalgrid

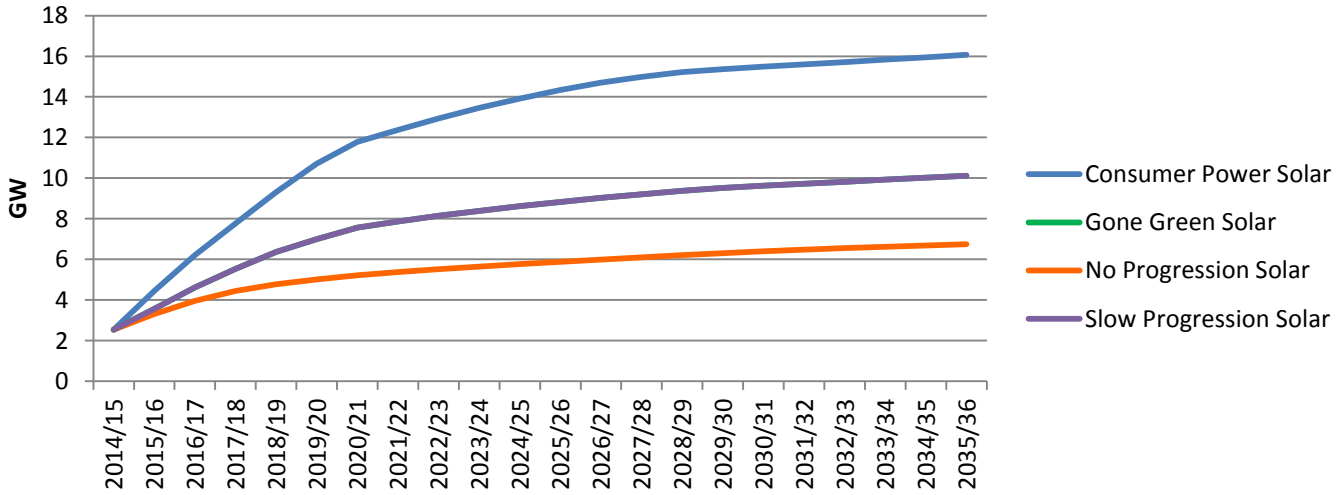


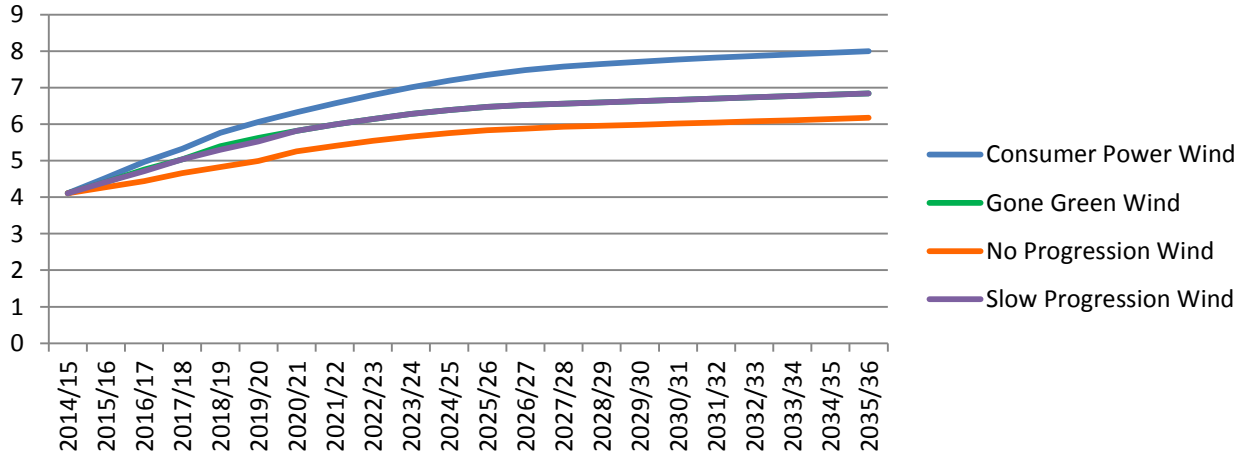
Distributed Generation (DG) Profiles



- Max/Min scenario delta: 11.9GW
- Over 20GW increase in DG under CP scenario in 20 year horizon
- Under NP, DG still anticipated to double in capacity over the course of the scenarios

Generation Profiles (DG) – Solar; Wind

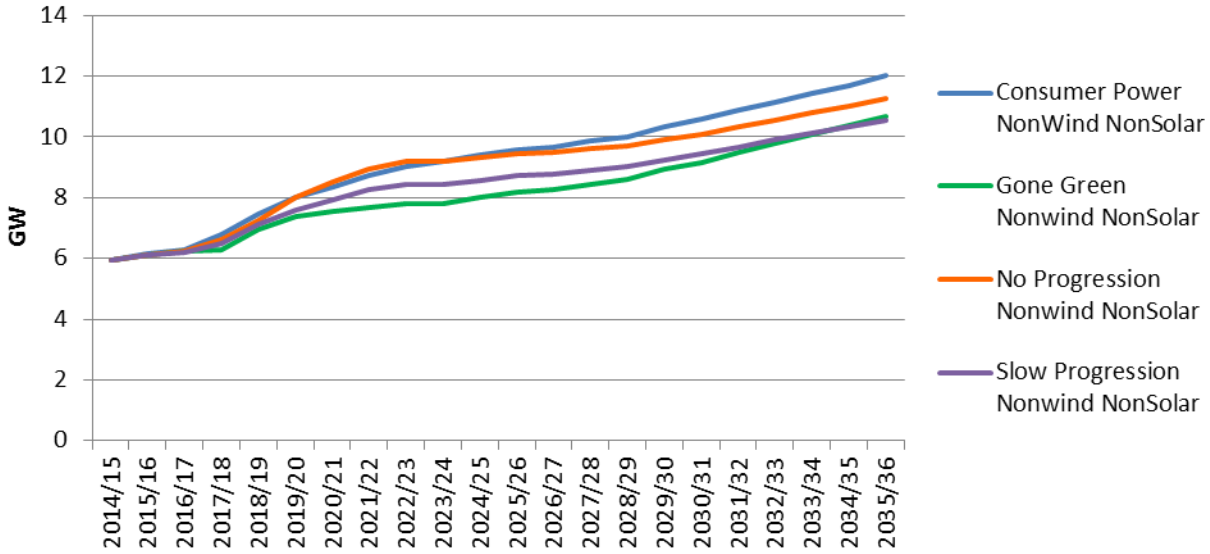




Gone Green = Slow Progression

nationalgrid

Generation Profiles (DG) – Non-Wind/Solar

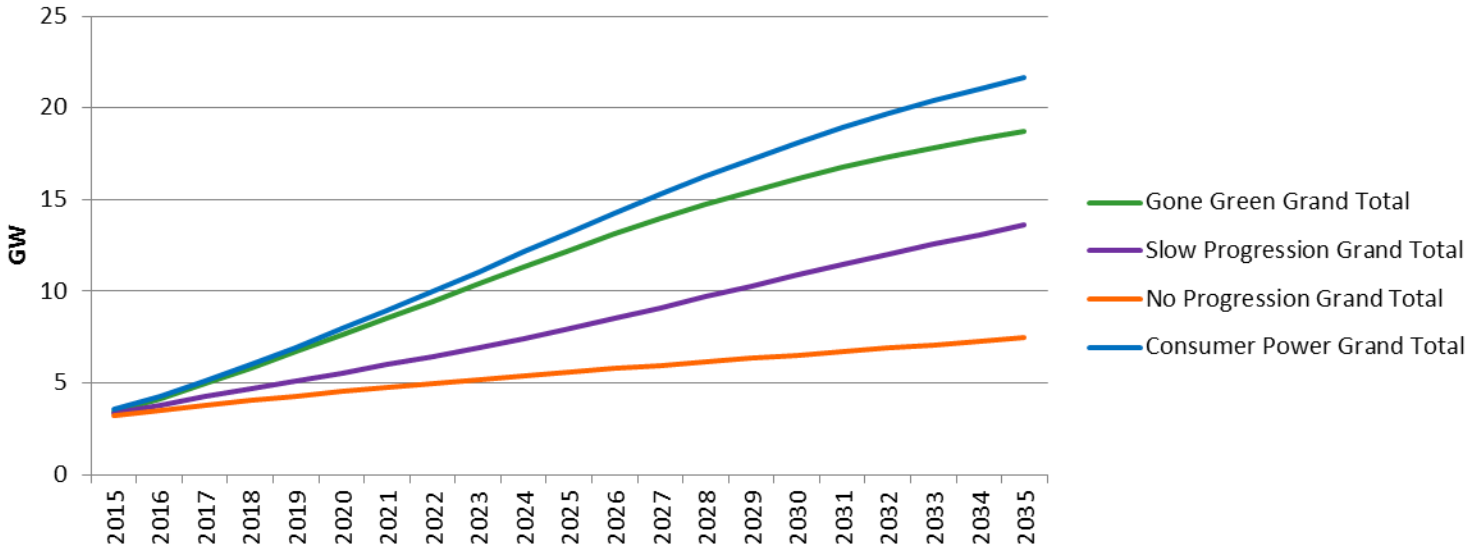


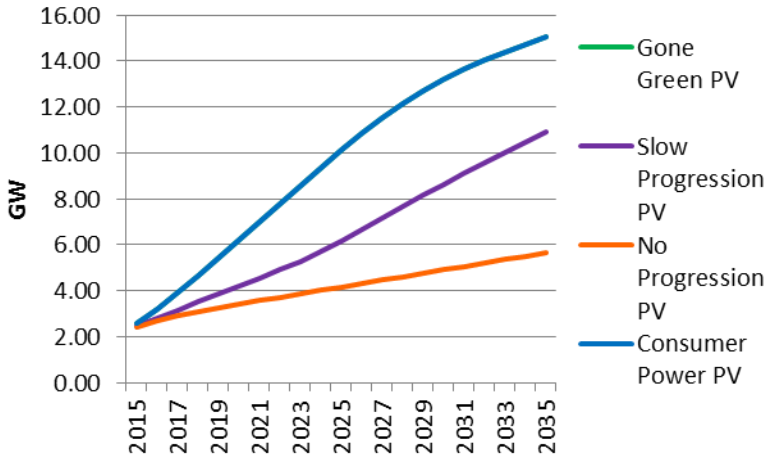
nationalgrid

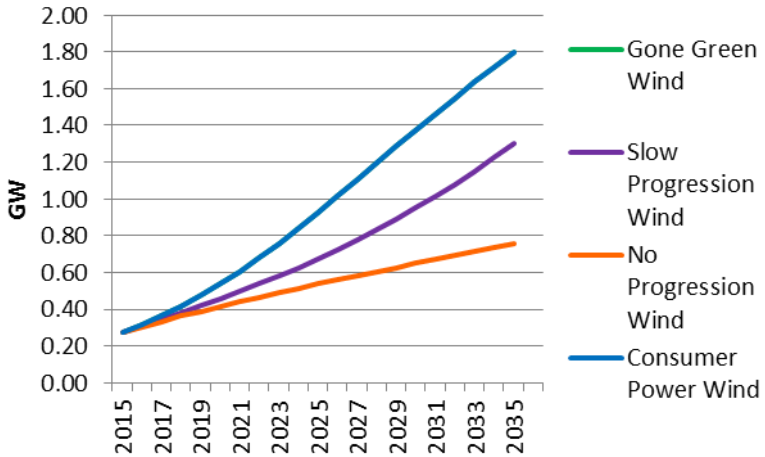
Sub 1MW Generation

Sub 1MW Generation Installed Capacity MW

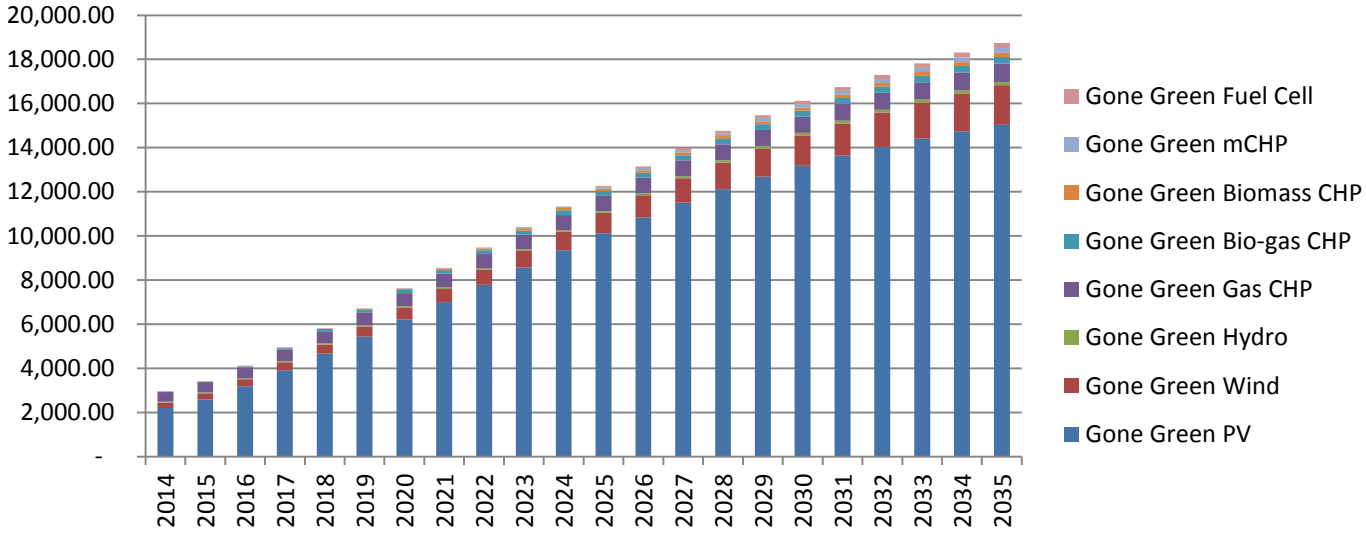
nationalgrid

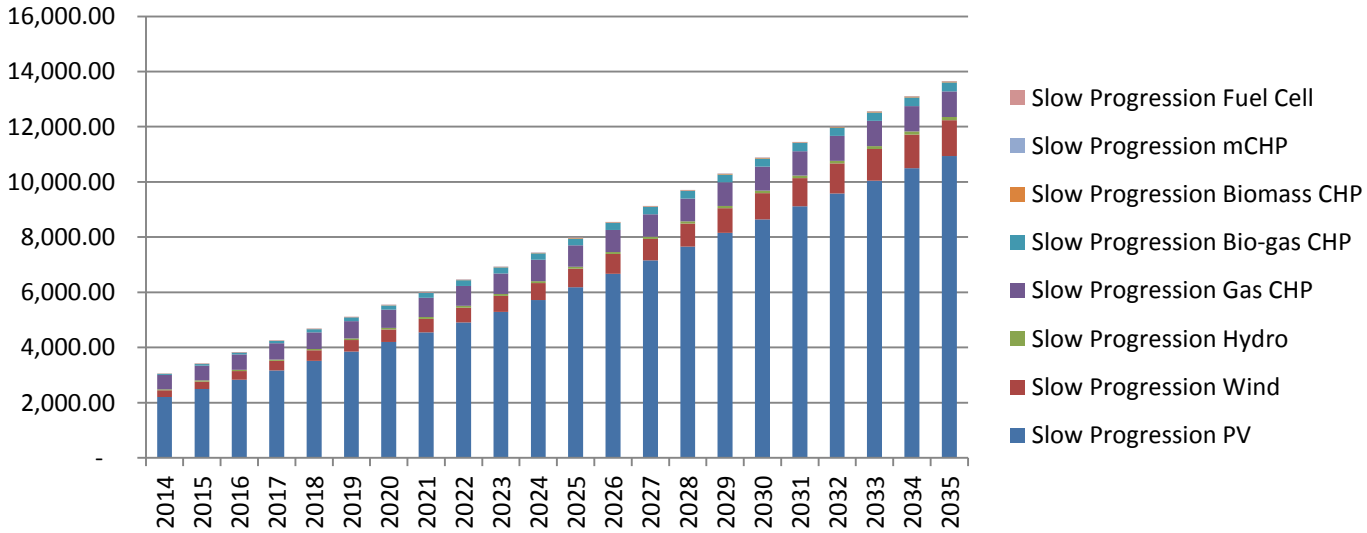




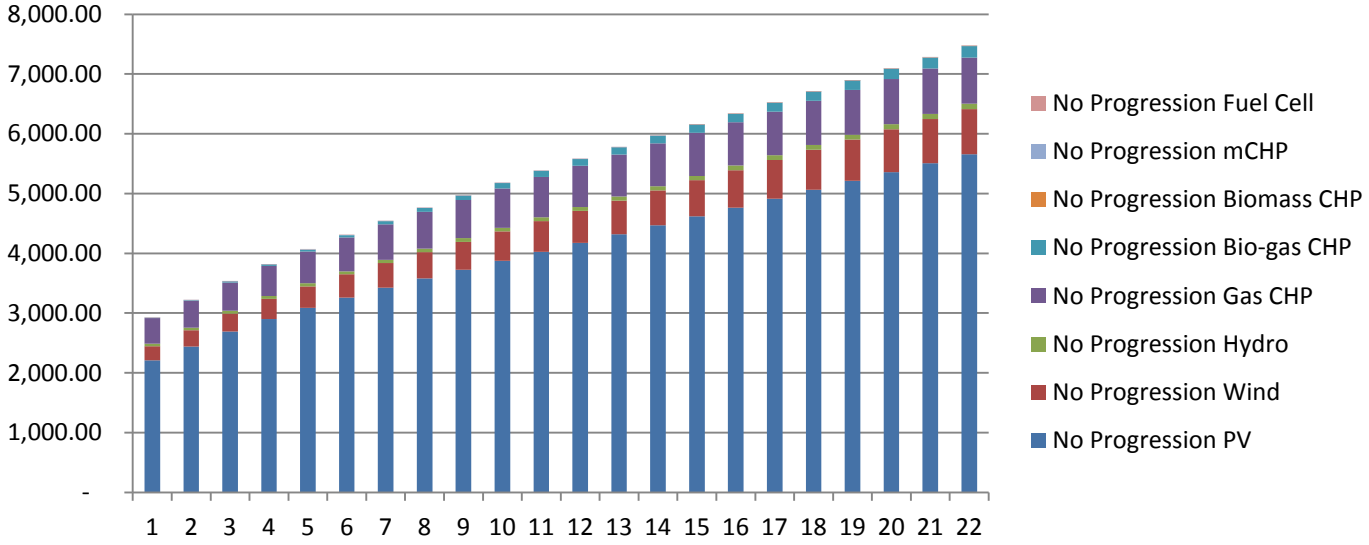


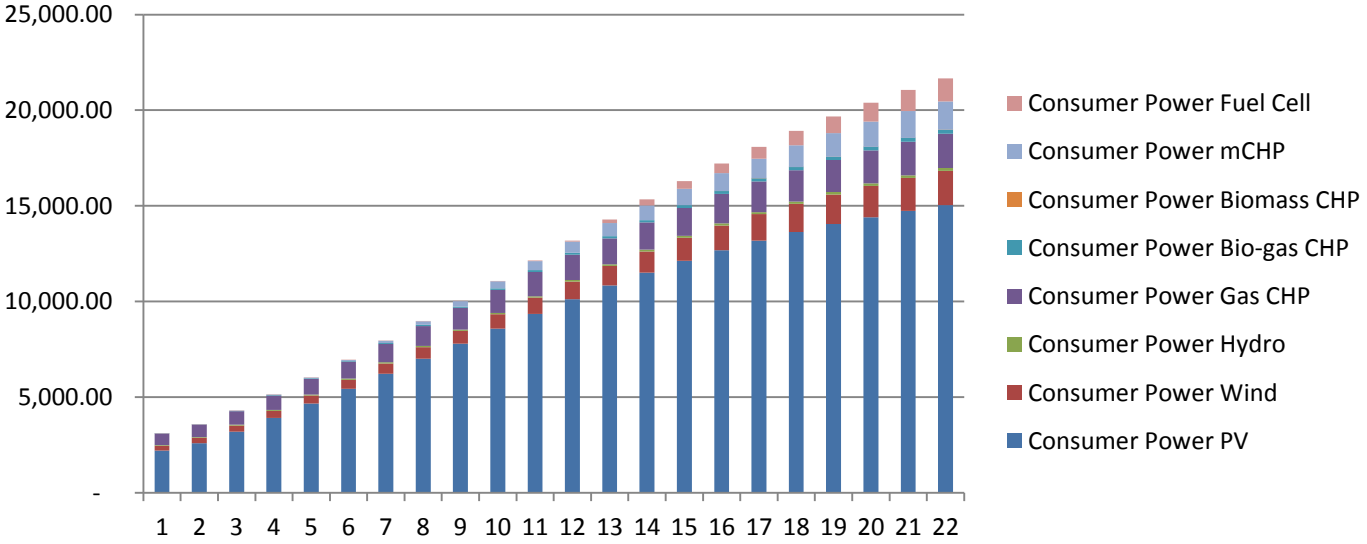
Sub 1MW Generation (Installed Capacity MW) Technology



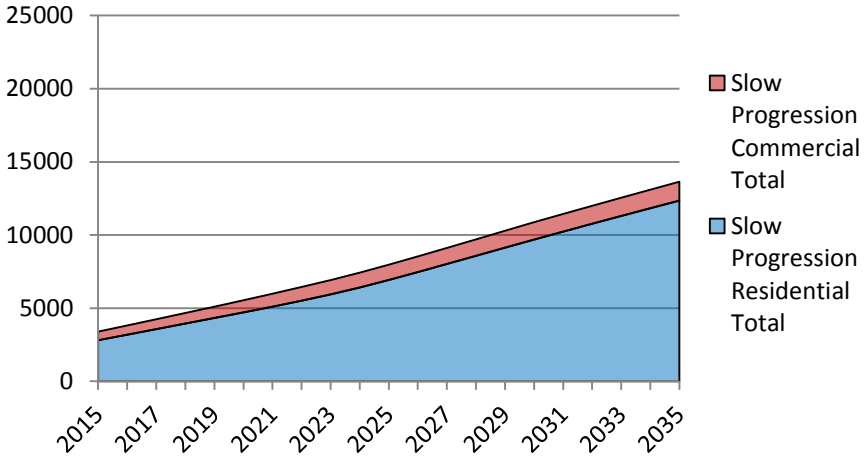


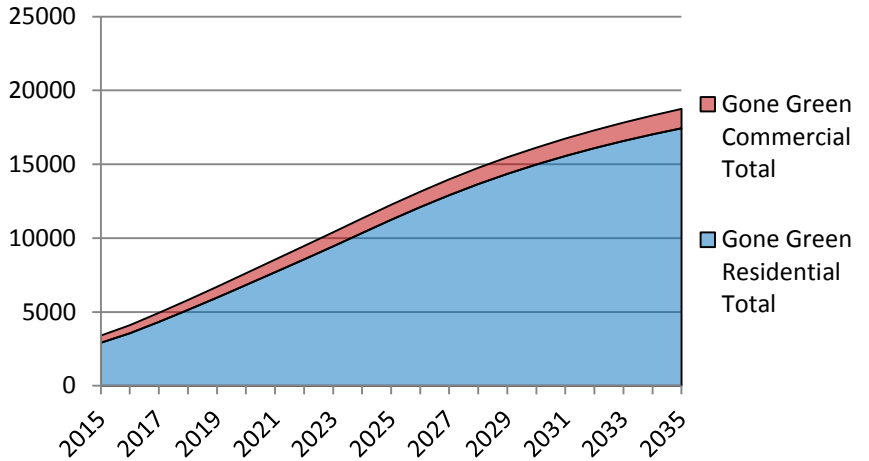
Sub 1MW Generation (Installed Capacity MW) Technology

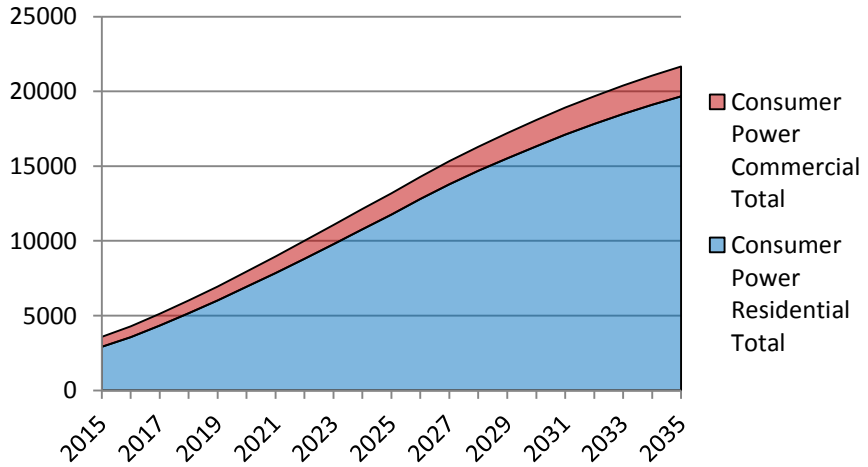


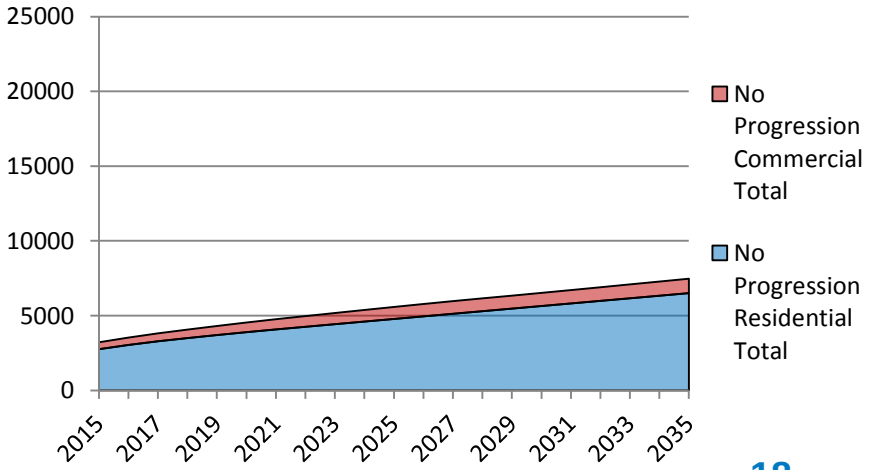


Sub 1MW Generation (Installed MW)
Residential vs Other I&C Split









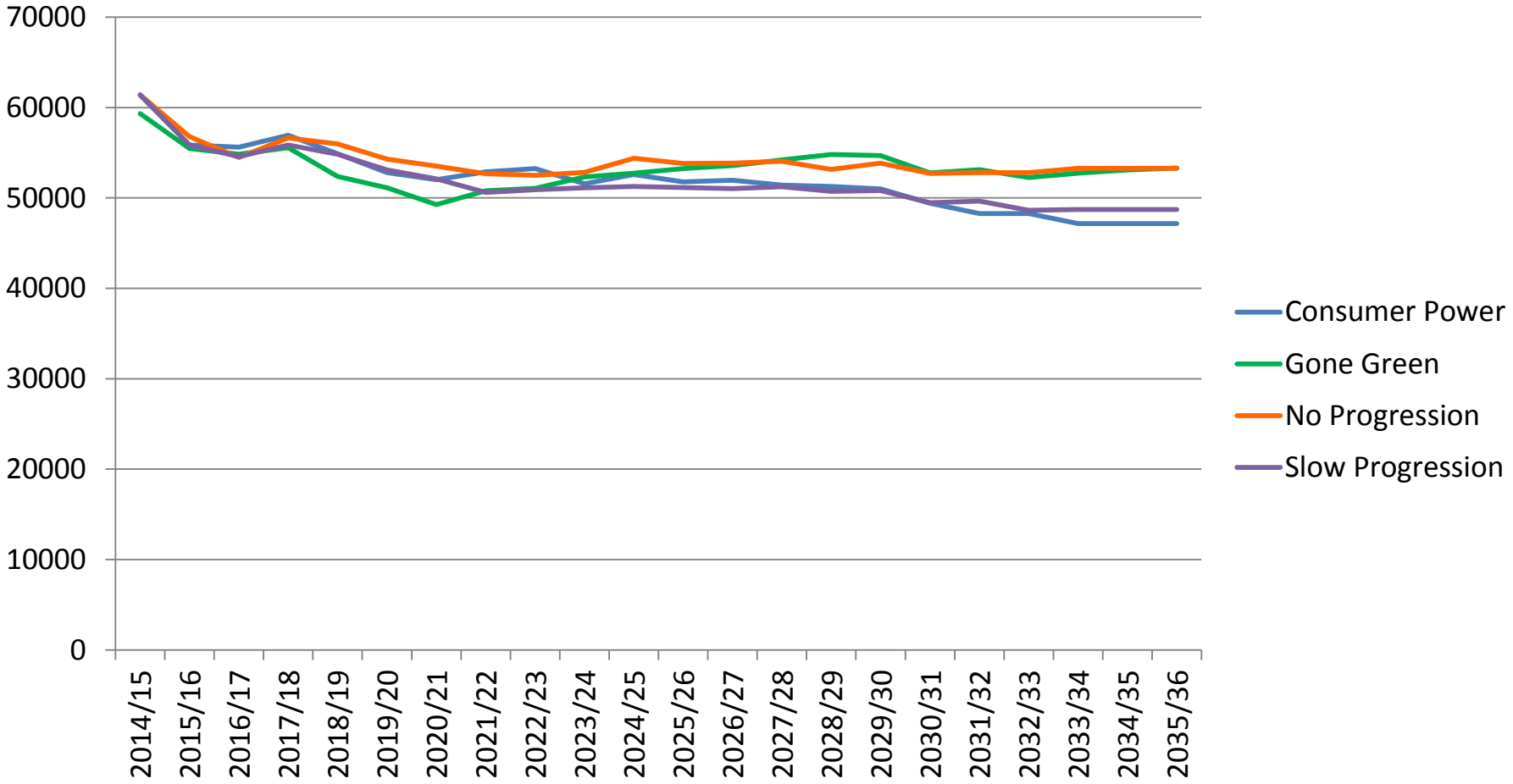
nationalgrid

Frequency Response

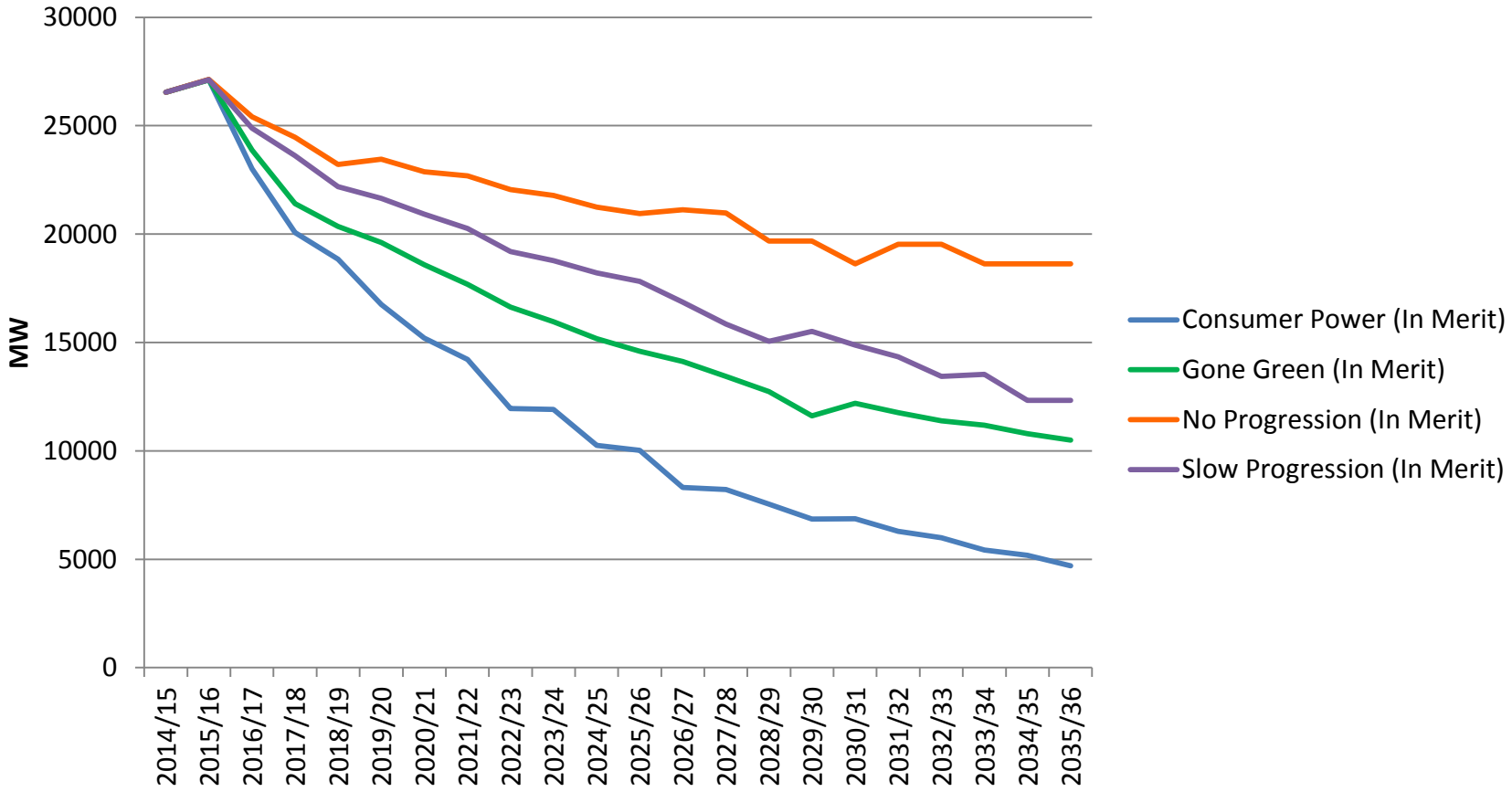
Pinch Point Definitions

- **Summer minimum** (PM) – Average summer's afternoon where demand is low, but where large volumes of un-instructable PV generation could spill onto the system
- **Winter Peak** – High demand periods where sufficient generation needs to be on the system (or capable of dispatch) to meet it, to avoid Frequency and inertia issues caused by unplanned System or generator outages/generator under-delivery etc.

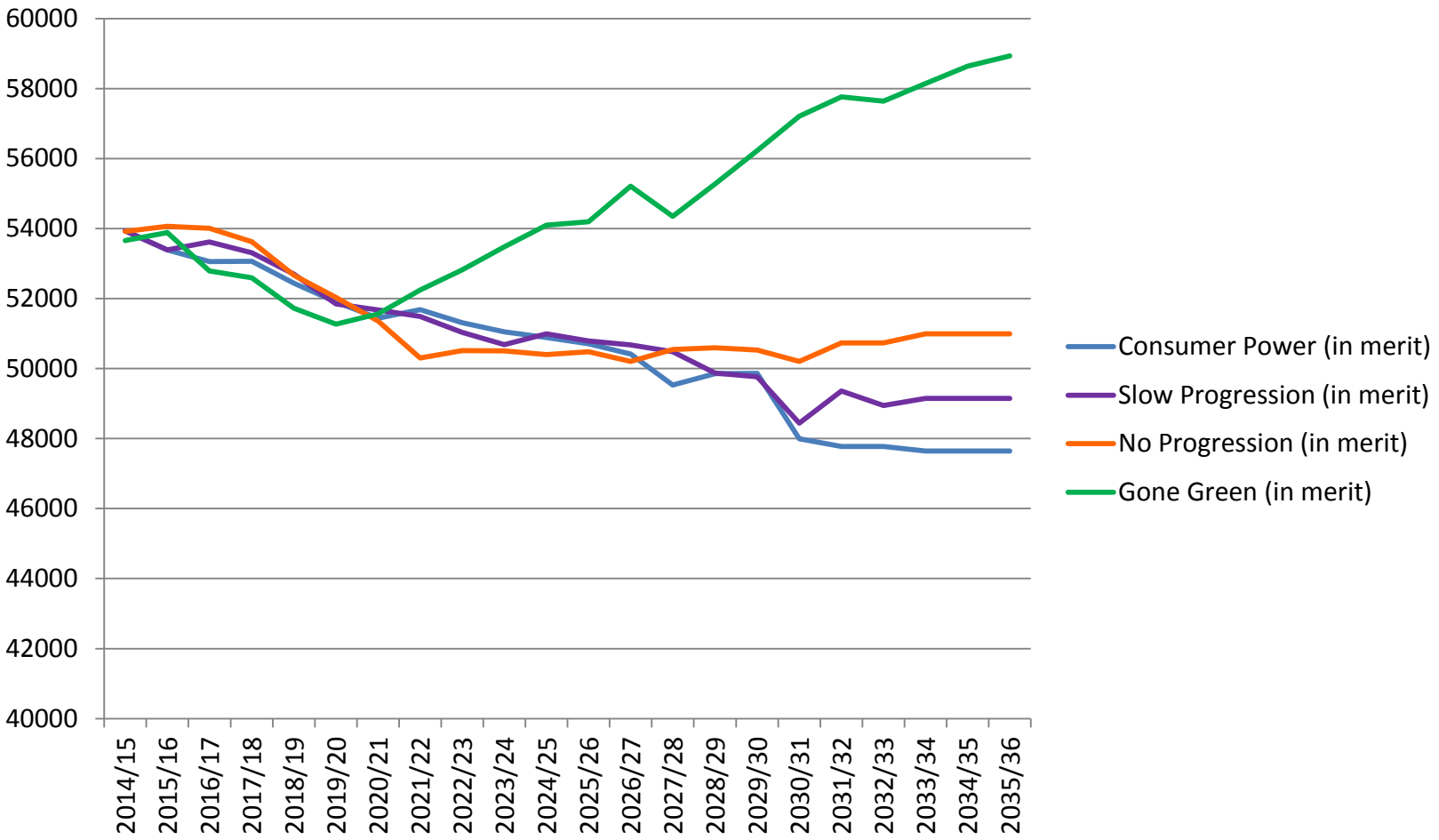
Potential Pool of Response Providers: Installed Capacity (MW)



Commercially available response (MW) @ Summer Minimum (PM)



Commercially available response (MW) @ Winter Peak



nationalgrid

Conclusions

nationalgrid

Conclusions (based on FES)…

- Significant proportion of new generation capacity in future years will be ‘invisible’ in real time to the TSO/DNOs, based on *today’s* connection and compliance requirements
- The majority of new capacity will be intermittent load (e.g. wind/PV), and is likely backed by a subsidy mechanism (CfD) which discourages providing balancing support
- Summer minimum will be particularly difficult for the TSO to manage
- Synchronous thermal plant (traditional balancing support providers) will consist primarily of gas; can/should new nuclear support?
- The co-ordination of TSOs, DNOs, suppliers, aggregators will be critical to manage this position in the coming years
- RfG banding has a big part to play in mitigating these viable concerns

nationalgrid

NGET Conclusions

- It is essential that we have the ability (perhaps through an aggregator/supplier) to instruct DG to maintain system security
  - Potentially also a huge market opportunity
- At the present time DG is not mandated to provide Ancillary Services. The options to mitigate are to either; (a) require some kind of support (via technical capability); or (b) to request disconnection in emergency circumstances?
- Fault Ride Through and reactive capability/ voltage support will need some consideration as will Grid Code / D Code requirements for micro generation.
- Whilst RfG was intended to address some of these issues it is unlikely to be strong enough particularly for micro plant.
- Aggregators or storage (batteries) could also help with this issue.

Next Steps

- [To be agreed]

nationalgrid

SUPPORTING INFORMATION

nationalgrid

More info on four scenarios

Consumer Power

Economic – moderate economic growth

Political – government policies focus on indigenous security of supply and carbon reduction

Technological – high innovation focused on market and consumer needs. High levels of local generation and a mixture of generation types at national level

Social – consumerism and quality of life drives behaviour and desire for 'going green', not a conscious decision

Environmental – Long-term UK carbon and renewable ambition becomes more relaxed

Gone Green

Economic – moderate economic growth

Political – European harmonisation and long-term environmental energy policy certainty

Technological – renewable and low carbon generation is high. Increased focus on green innovation

Social – society actively engaged in 'going green'

Environmental – new policy intervention ensuring all carbon and renewable targets are achieved

No Progression

Economic – slower economic growth

Political – inconsistent political statements and a lack of focus on environmental energy policies

Technological – little innovation occurs in the energy sector with gas as the preferred choice for generation over low carbon

Social – society is cost conscious and focused on the here and now

Environmental – reduced low carbon policy support and limited new interventions

Slow Progression

Economic – slower economic growth

Political – European harmonisation, focus on low cost environmental energy policies

Technological – medium levels of innovation lead to a focus on a mixture of renewable and low carbon technologies

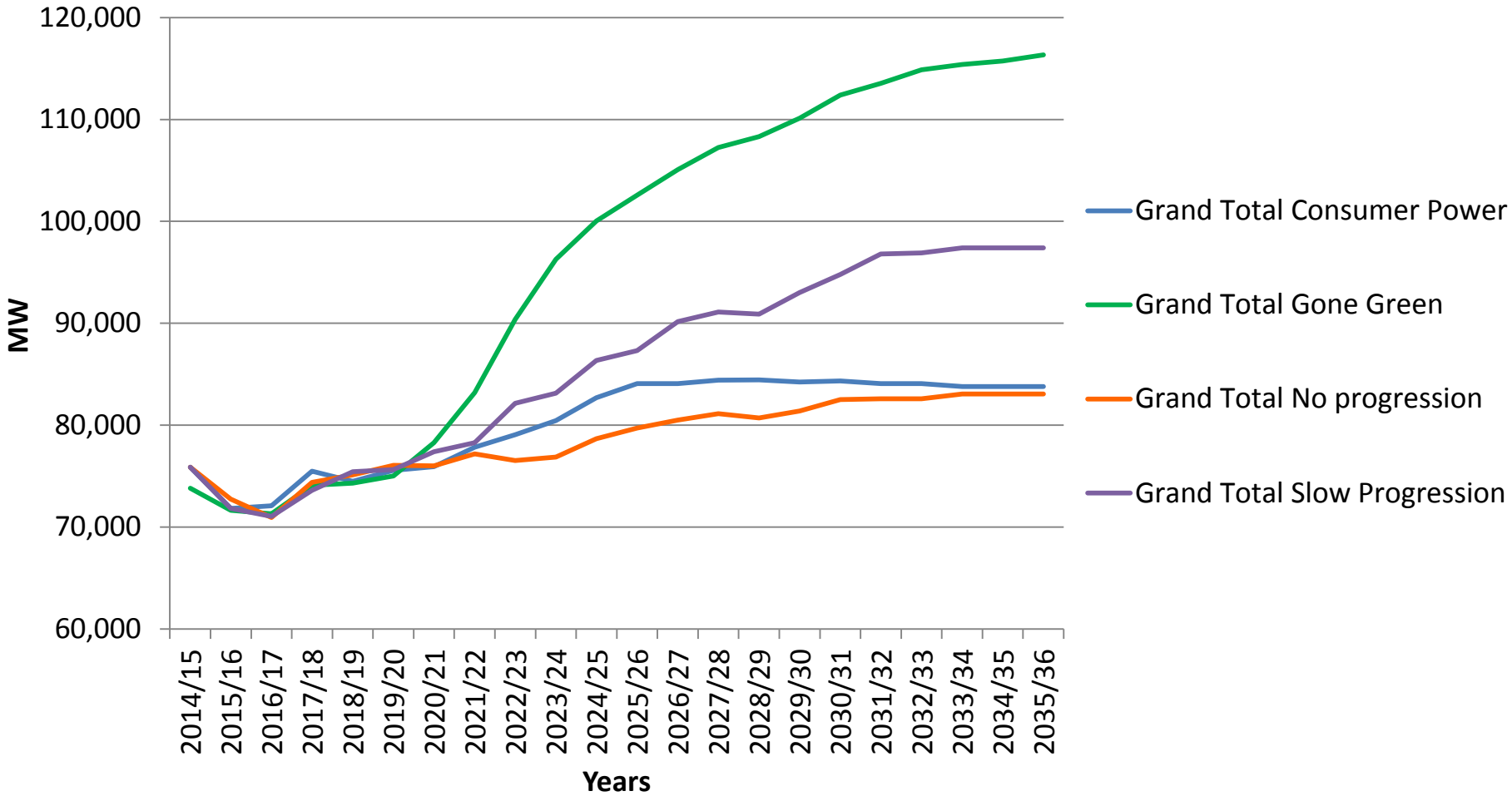
Social – society is engaged in 'going green' but choices are limited by cost

Environmental – new policy interventions are constrained by affordability

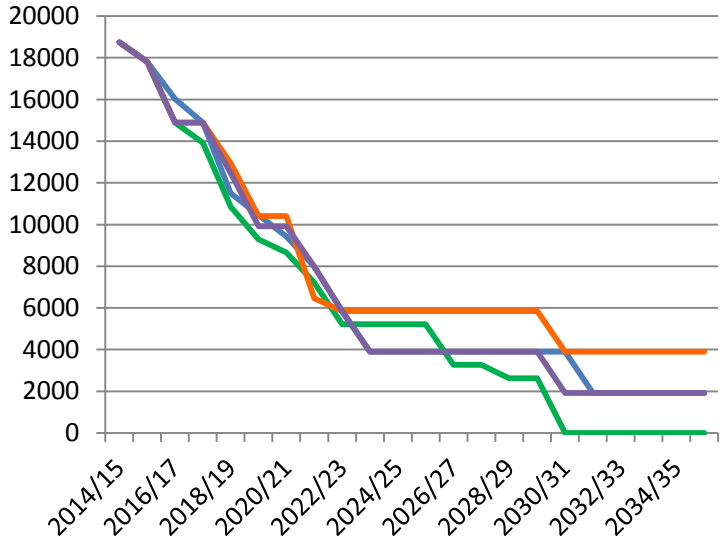
nationalgrid

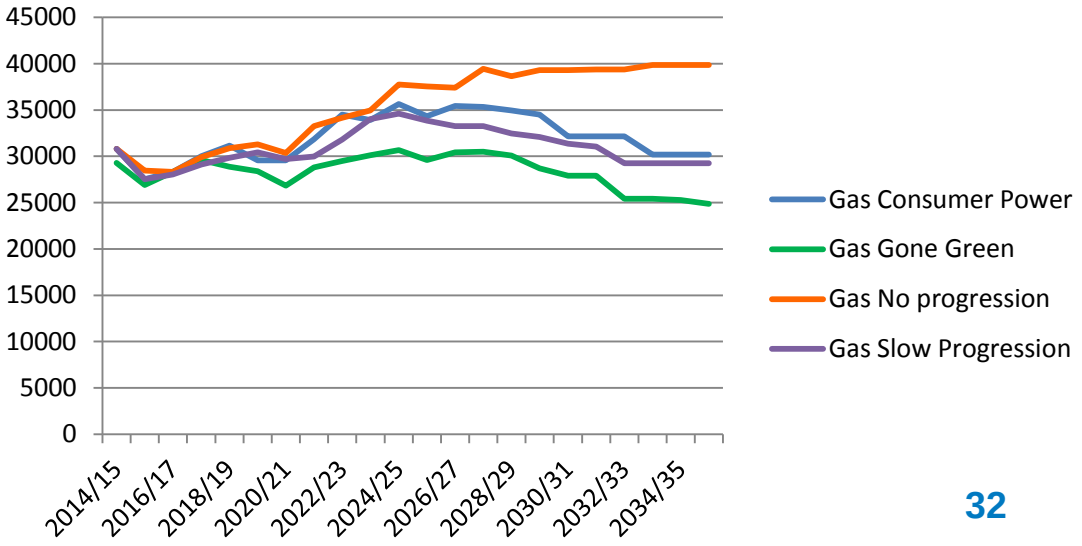
Transmission Generation

Transmission (Tx) Generation: Total Capacity (MW)

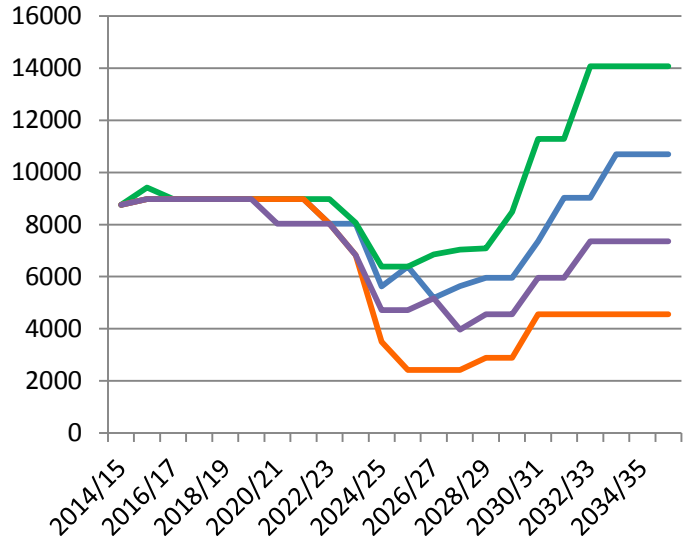


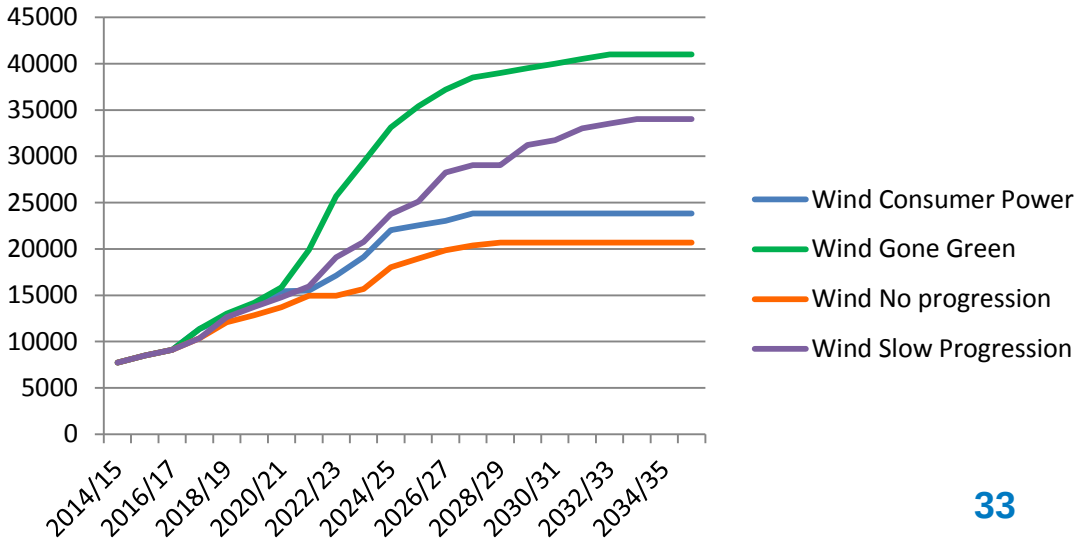
Tx Generation Capacity (MW): Coal; Gas



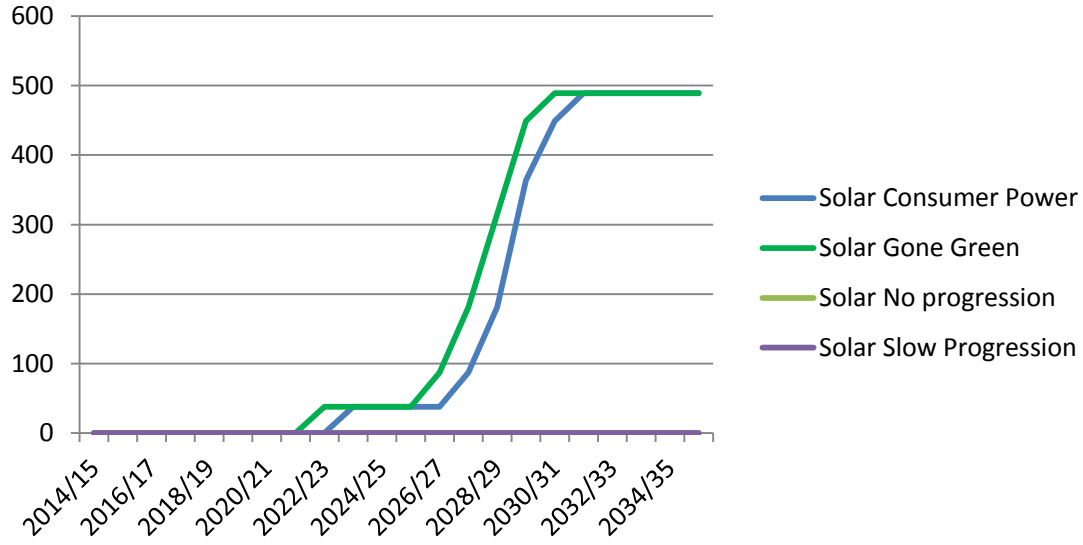


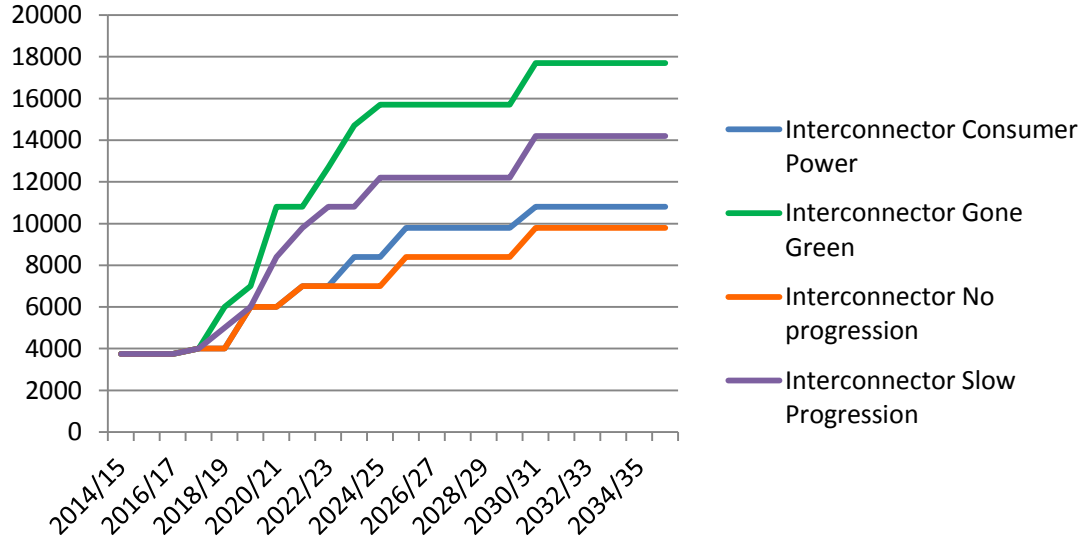
Tx Generation Capacity (MW): Nuclear; Wind





Tx Generation Capacity (MW): Solar; Interconnector





nationalgrid

Generation Capacity Changes

Technology	Scenario	Start MW	End MW	Change MW	Change %
Biomass	Slow Progression	1087	2567	1480	136.15%
Biomass	Gone Green	1087	677	-410	-37.72%
Biomass	Consumer Power	1087	397	-690	-63.48%
Biomass	No progression	1087	397	-690	-63.48%
Coal	No progression	18748	3902	-14846	-79.19%
Coal	Consumer Power	18748	1914	-16834	-89.79%
Coal	Slow Progression	18748	1914	-16834	-89.79%
Coal	Gone Green	18748	0	-18748	-100.00%
Gas	No progression	30791	39866	9075	29.47%
Gas	Consumer Power	30791	30201	-590	-1.92%
Gas	Slow Progression	30791	29261	-1530	-4.97%
Gas	Gone Green	29296	24878	-4418	-15.08%

nationalgrid

Generation Capacity Changes

Technology	Scenario	Start MW	End MW	Change MW	Change %
Nuclear	Gone Green	8756	14079	5323	60.79%
Nuclear	Consumer Power	8756	10692	1936	22.11%
Nuclear	Slow Progression	8756	7352	-1404	-16.03%
Nuclear	No progression	8756	4552	-4204	-48.01%
Hydro	Consumer Power	1122	1122	0	0.00%
Hydro	Gone Green	1122	1122	0	0.00%
Hydro	No progression	1122	1122	0	0.00%
Hydro	Slow Progression	1122	1122	0	0.00%
Interconnector	Gone Green	3750	17700	13950	372.00%
Interconnector	Slow Progression	3750	14200	10450	278.67%
Interconnector	Consumer Power	3750	10800	7050	188.00%
Interconnector	No progression	3750	9800	6050	161.33%

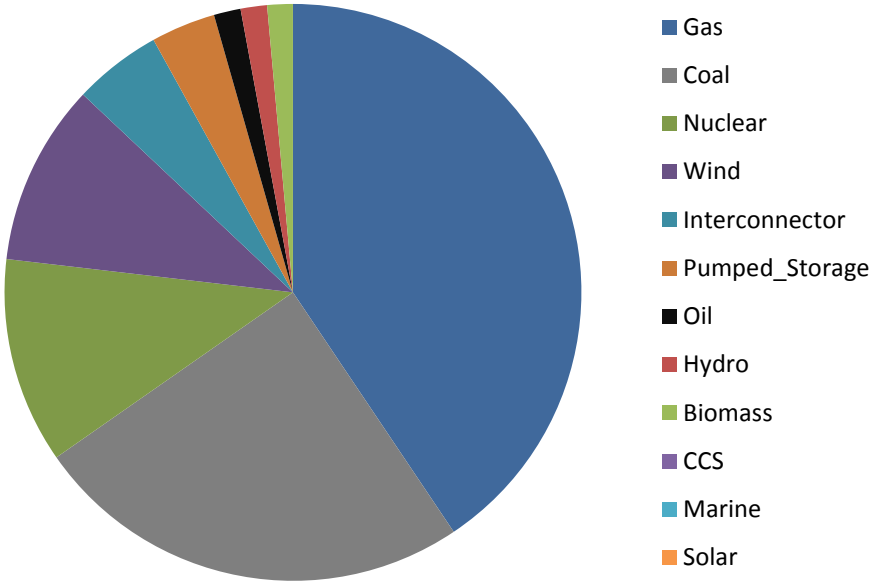
nationalgrid

Generation Capacity Changes

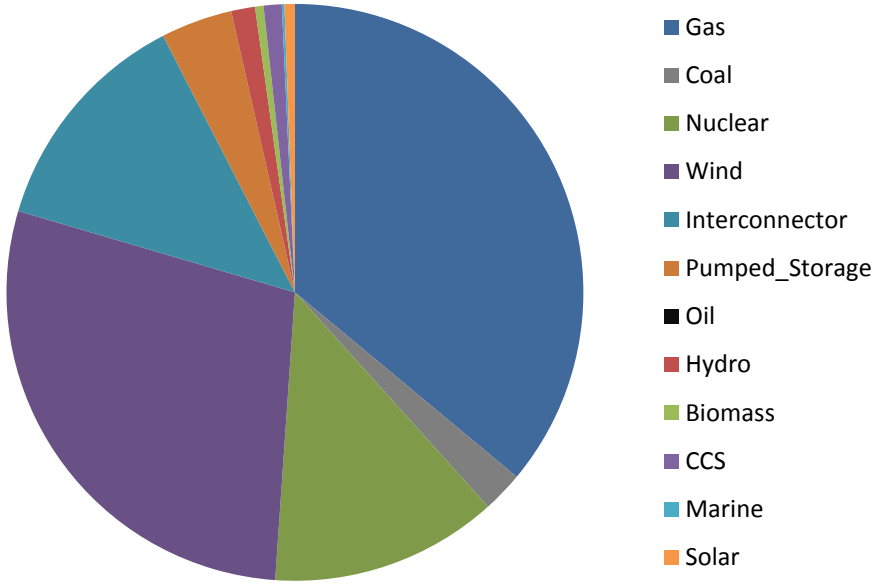
Technology	Scenario	Start MW	End MW	Change MW	Change %
Oil	Consumer Power	1140	0	-1140	-100.00%
Oil	Gone Green	570	0	-570	-100.00%
Oil	No progression	1140	0	-1140	-100.00%
Oil	Slow Progression	1140	0	-1140	-100.00%
Pumped Storage	Gone Green	2744	5256	2512	91.55%
Pumped Storage	Consumer Power	2744	3356	612	22.30%
Pumped Storage	Slow Progression	2744	3356	612	22.30%
Pumped Storage	No progression	2744	2744	0	0.00%
Wind	Gone Green	7723	41010.5	33287.5	431.02%
Wind	Slow Progression	7723	34026	26303	340.58%
Wind	Consumer Power	7723	23843	16120	208.73%
Wind	No progression	7723	20677	12954	167.73%

Generation Mix

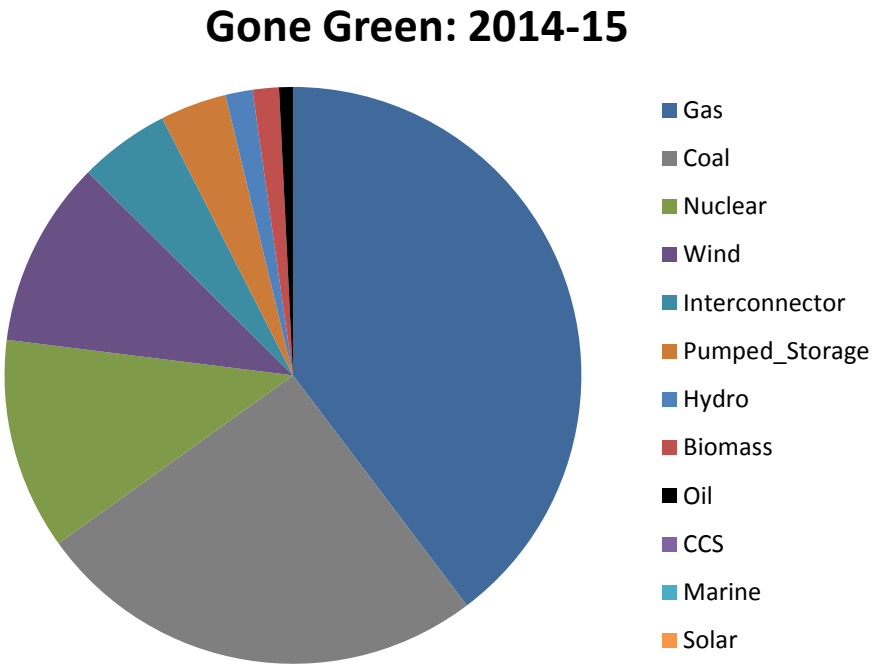
Consumer Power: 2014-15

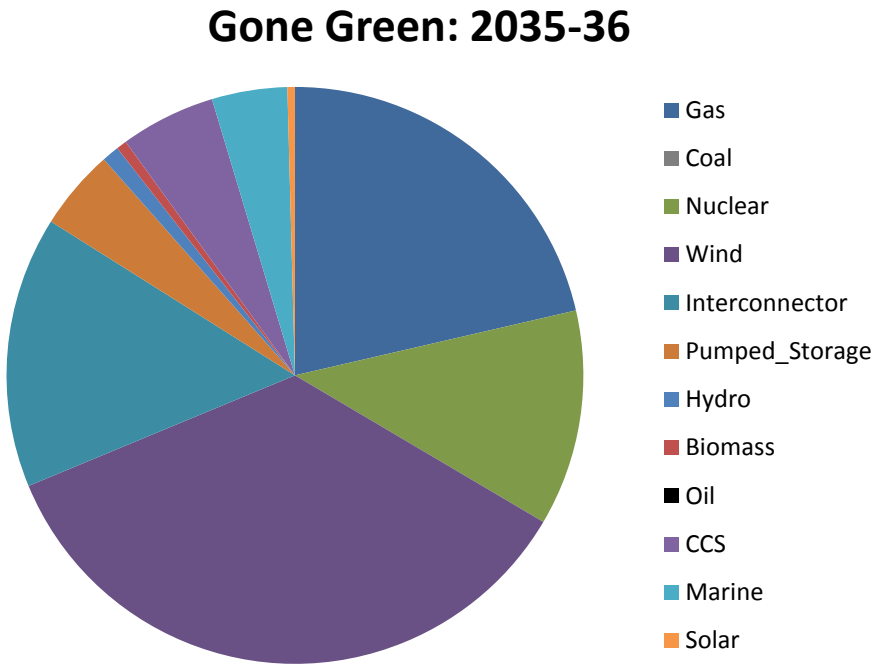


Consumer Power: 2035-36

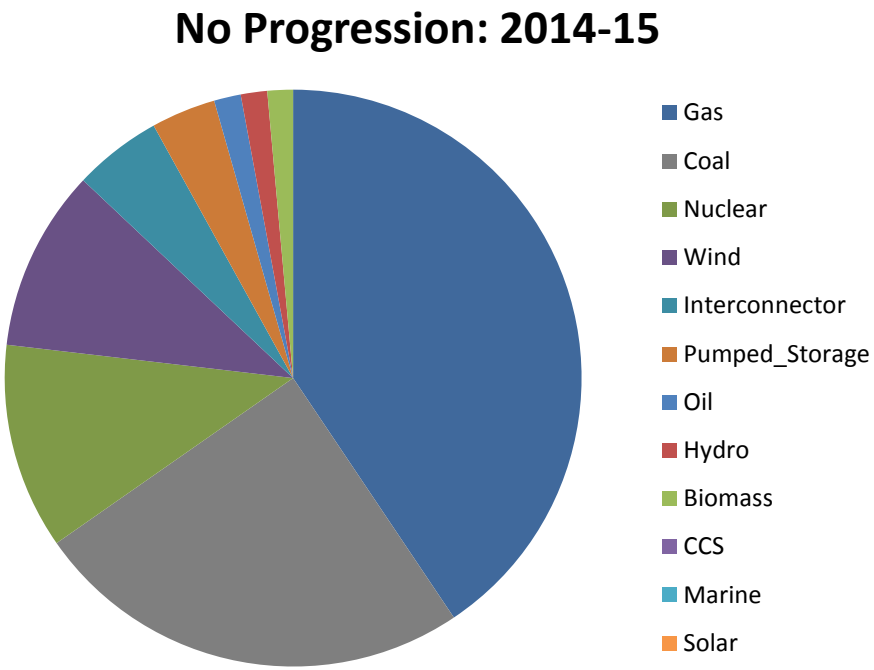


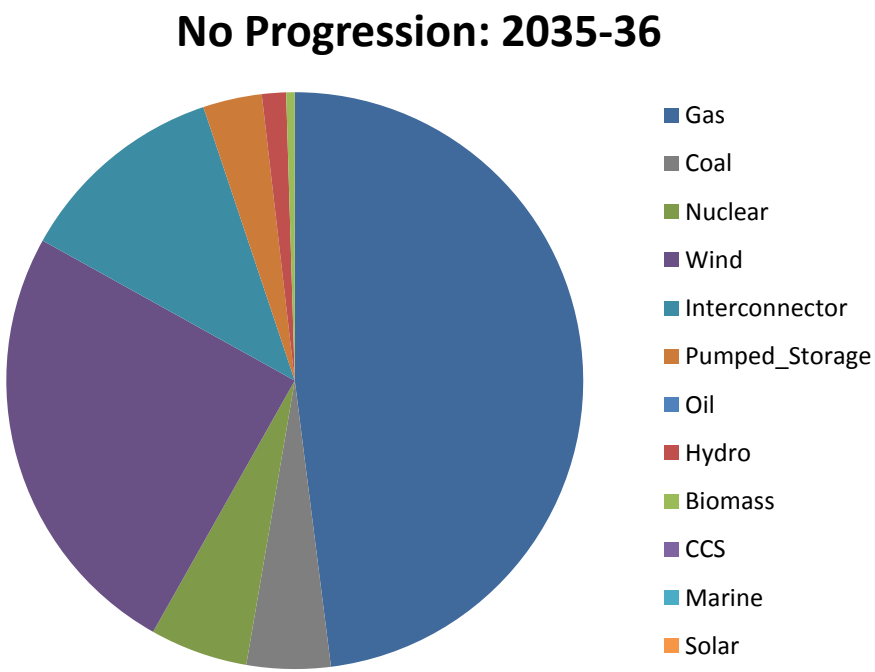
Generation Mix





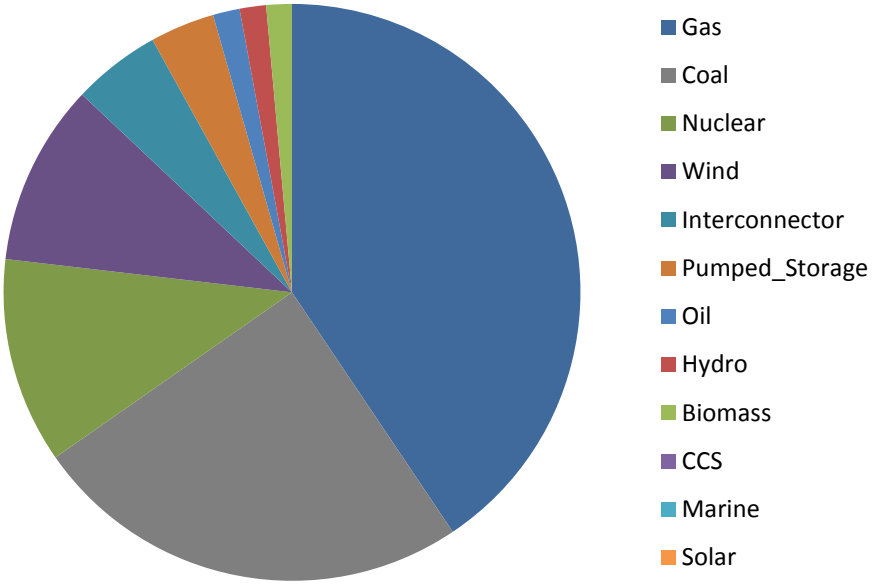
Generation Mix





Generation Mix

Slow Progression: 2014-15



Slow Progression: 2035-36