Demand Estimation Sub Committee

5.0 Seasonal Normal Review 2025

04 October 2023

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BACKGROUND, OVERVIEW, TIMETABLE AND OBJECTIVES

Background

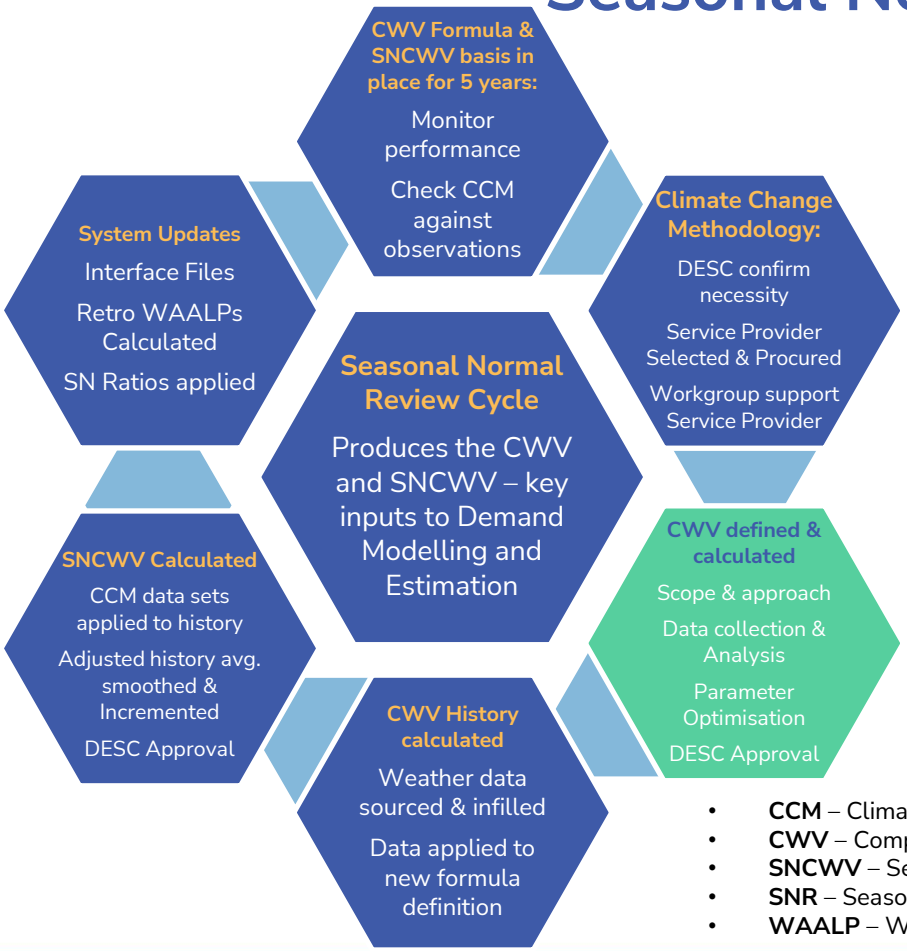
- DESC are responsible for a number of obligations in Section H of UNC, amongst them are the requirements to:
  - Review the Composite Weather Variable (CWV) (H 1.4.3) and
  - Review the Seasonal Normal equivalent referred to as the SNCWV (H 1.5.3)

- Reviews of the CWV formula and Seasonal Normal basis are normally only carried out by DESC every 5 years due to the time taken to perform the review and the need for stability. This would mean the next Seasonal Normal basis is scheduled to take effect from 01 October 2025

- DESC confirmed the next steps in the procurement of a Climate Change Methodology at it's meeting on 05 July 2023. This work is due to take place in the first half of 2024

- The latest DESC review derived a new CWV formula and new basis for the Seasonal Normal, which both came into effect from the 01 October 2020

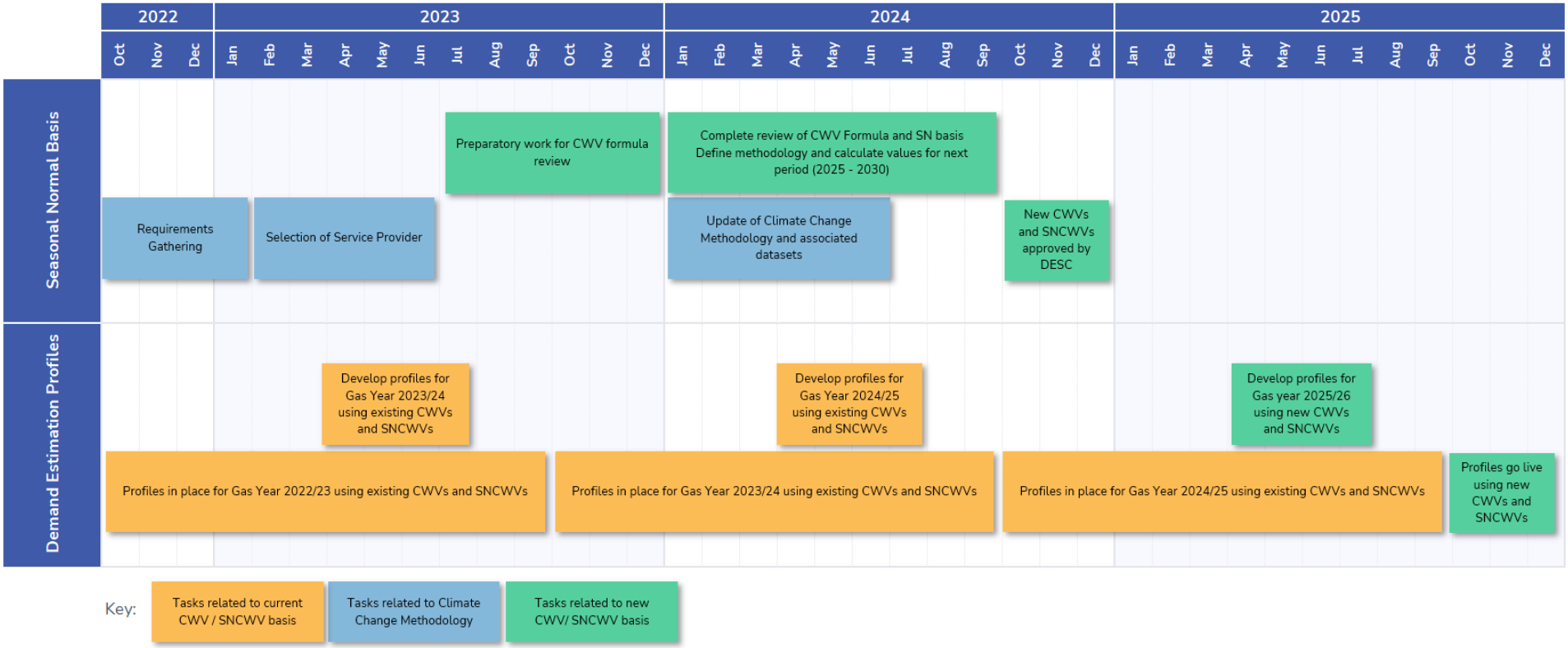
Seasonal Normal Review



- An overview of the Demand Estimation process and output can be found here
- Composite Weather Variable (CWV) and Seasonal Normal CWV (SNCWV) are key inputs to the Demand estimation process
- Seasonal Normal Review (SNR) cycle, undertaken at minimum once every 5 years, represented in diagram opposite
- This presentation relates to the "**CWV Defined and Calculated**" phase of the SNR cycle

- **CCM** – Climate Change Methodology
- **CWV** – Composite Weather Variable
- **SNCWV** – Seasonal Normal **CWV**
- **SNR** – Seasonal Normal Review
- **WAALP** – Weather Adjusted Annual Load Profile

High level Timeline



Objectives

- Present findings of analysis of precipitation data
- Outline the scope and approach of the CWV optimisation
- Provide an update on next steps of the Seasonal Normal Review, including the refresh of the Climate Change Methodology (CCM)

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CWV FORMULA REVIEW

Precipitation Data Analysis - Approach

- In order to assess whether there is clear evidence that Precipitation would enhance the CWV formula, raw Precipitation data was sourced for two weather stations - Heathrow and Glasgow Bishopton - for Gas Years 2015/16 to 2021/22

- A Precipitation term was added to the current CWV formula as a ‘stand alone’ term and trialed using the following definitions:

CWV Term	CWV Definition
CWV	Current CWV Definition, No precipitation
PCWV1	Precipitation uses Temperature hourly Weightings
PCWV2	Precipitation Weightings all (1/24)
PCWV3	Precipitation uses Temperature hourly Weightings, P0 = 0.2
PCWV4	Precipitation uses Temperature hourly Weightings, P0 = 0.6
PCWV5	Precipitation uses negative Temperature hourly Weightings

- These precipitation terms were added to the CWV formula and regression analysis against ‘Aggregate NDM Demand’ was performed (using R squared (R^2) Multiple Correlation Coefficient), to assess whether there was an improvement to the existing CWV definition

Precipitation Data - Results

- As can be seen in Table 1 below, in almost all LDZs across different Gas Years, the current CWV definition performed better against trial CWV definitions which included a precipitation term

- Table 2 shows the R^2 values by LDZ and Season, some marginal improvements were made in certain LDZ/Seasons when using PCWV3 definition, however in the majority of cases the current CWV was as good as or better than the definitions which included a precipitation term

Table 1: R^2 results by LDZ and Gas Year

LDZ	Gas Year	CWV	PCWV1	PCWV2	PCWV3	PCWV4	PCWV5
EA	2018	0.9907	0.9895	0.9896	0.9906	0.9902	0.9905
EA	2019	0.9859	0.9849	0.9851	0.9858	0.9855	0.9855
EA	2020	0.9864	0.9858	0.9857	0.9864	0.9863	0.9863
EA	2021	0.9872	0.9870	0.9869	0.9872	0.9872	0.9870
NT	2018	0.9932	0.9919	0.9920	0.9931	0.9926	0.9928
NT	2019	0.9897	0.9887	0.9889	0.9896	0.9893	0.9893
NT	2020	0.9886	0.9879	0.9878	0.9886	0.9884	0.9884
NT	2021	0.9899	0.9893	0.9893	0.9899	0.9897	0.9896
SC	2018	0.9842	0.9813	0.9821	0.9842	0.9833	0.9831
SC	2019	0.9824	0.9785	0.9787	0.9825	0.9815	0.9816
SC	2020	0.9885	0.9851	0.9853	0.9883	0.9871	0.9872
SC	2021	0.9829	0.9801	0.9808	0.9828	0.9818	0.9819
SE	2018	0.9935	0.9916	0.9916	0.9933	0.9926	0.9928
SE	2019	0.9909	0.9892	0.9893	0.9907	0.9901	0.9901
SE	2020	0.9896	0.9882	0.9881	0.9895	0.9890	0.9890
SE	2021	0.9886	0.9876	0.9875	0.9885	0.9881	0.9881

Table 2: R^2 results by LDZ and Season

LDZ	Season	CWV	PCWV1	PCWV2	PCWV3	PCWV4	PCWV5
EA	Autumn	0.9667	0.9636	0.9639	0.9664	0.9654	0.9657
EA	Winter	0.9383	0.9368	0.9368	0.9384	0.9380	0.9380
EA	Spring	0.9710	0.9700	0.9698	0.9712	0.9710	0.9710
EA	Summer	0.8569	0.8446	0.8477	0.8565	0.8525	0.8523
NT	Autumn	0.9721	0.9686	0.9687	0.9717	0.9705	0.9707
NT	Winter	0.9537	0.9509	0.9509	0.9536	0.9526	0.9527
NT	Spring	0.9764	0.9751	0.9749	0.9765	0.9761	0.9762
NT	Summer	0.9155	0.9042	0.9071	0.9147	0.9113	0.9114
SC	Autumn	0.9506	0.9332	0.9348	0.9489	0.9428	0.9428
NT	Winter	0.9537	0.9509	0.9509	0.9536	0.9526	0.9527
SC	Spring	0.9545	0.9532	0.9535	0.9549	0.9547	0.9545
SC	Summer	0.8354	0.8290	0.8320	0.8387	0.8387	0.8369
SE	Autumn	0.9748	0.9702	0.9703	0.9743	0.9727	0.9728
SE	Winter	0.9535	0.9482	0.9482	0.9529	0.9510	0.9510
SE	Spring	0.9757	0.9734	0.9733	0.9757	0.9750	0.9752
SE	Summer	0.8517	0.8396	0.8428	0.8508	0.8471	0.8468

Note: Data not show for Gas Years 2015/16 to 2017/18 follows a similar trend

Key: Current CWV | Increase R^2 | No Change | Decrease R^2

Precipitation Data - Conclusions

- Adding a subtractive Precipitation term to the existing formula does not appear to create any obvious improvements in the relationship between CWV and Daily Aggregate NDM Demand

- Due to the localised nature of Precipitation, it is difficult to determine a reliable term

- Unless there are any differing views within DESC, it is recommended that Precipitation is not included in the scope of the CWV formula review

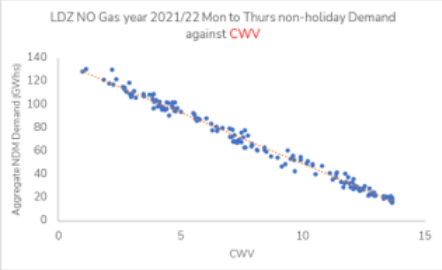
Scope of CWV Review – Outline of approach

- The CWV is a single measure of daily weather in each LDZ and is a function of actual temperature, wind speed, solar radiation, effective temperature, Seasonal Normal Effective Temperature(SNET), and Seasonal Normal Effective Solar (SNES). The definition of CWV includes provision for summer cut-offs and cold weather upturn during low temperature extremes, defined such that a linear relationship applies between daily demand in the LDZ and the CWV.

- The current CWV Formula and Parameters for all LDZs are shown below

$$\mathbf{CW_t = I_1 * E_t + (1.0 - I_1) * S_t - I_2 * Max(0, W_t - W_0) * Max(0, T_0 - AT_t) + S_0 * SR_t + P_0 * P_t}$$

$$\mathbf{CWV_t = V1 + q * (V2 - V1)} \quad \text{if } \mathbf{V_2 \le CW_t} \quad \text{(summer cut-off)}$$
$$\mathbf{CWV_t = V1 + q * (CW_t - V1)} \quad \text{if } \mathbf{V_1 < CW_t < V2} \quad \text{(transition)}$$
$$\mathbf{CWV_t = CW_t} \quad \text{if } \mathbf{V_0 \le CW_t \le V1} \quad \text{(normal)}$$
$$\mathbf{CWV_t = CW_t + I3 * (CW_t - V0)} \quad \text{if } \mathbf{V_0 > CW_t} \quad \text{(cold weather upturn)}$$



Example: CWV vs Aggregate NDM Demand

LDZ	y	I_1	I_2	I_3	V_0	V_1	V_2	q	W_0	T_0	S_0
SC	0.505	0.680	0.011	0.000	1.053	12.590	16.402	0.509	-2.992	15.476	0.507
NO	0.492	0.646	0.008	0.126	5.000	12.005	15.779	0.438	-0.894	16.657	0.950
NW	0.498	0.646	0.009	0.315	2.694	12.775	16.466	0.513	-5.000	21.312	0.802
NE	0.459	0.672	0.009	0.083	-1.261	12.924	16.679	0.446	-1.652	21.596	0.568
EM	0.480	0.689	0.010	0.138	-1.344	13.008	16.897	0.424	-2.417	17.377	0.698
WM	0.471	0.692	0.010	0.163	4.385	13.392	17.480	0.368	-3.619	17.569	0.678
WN	0.482	0.618	0.009	0.324	3.773	13.477	16.987	0.445	-3.926	18.249	0.679
WS	0.543	0.657	0.008	0.079	1.797	13.826	17.186	0.384	-1.910	17.068	0.776
EA	0.460	0.723	0.015	0.109	-0.235	15.131	18.885	0.368	-0.477	12.650	0.635
NT	0.473	0.715	0.015	0.066	4.898	15.029	19.184	0.429	-3.811	12.833	0.695
SE	0.484	0.772	0.006	0.266	1.335	13.996	18.523	0.375	-0.721	21.613	0.566
SO	0.438	0.692	0.015	0.405	0.141	14.745	18.715	0.345	-2.076	11.978	0.559
SW	0.448	0.623	0.008	0.258	3.476	13.254	17.898	0.337	0.705	21.707	0.801

Scope of CWV Review – Outline of approach

- The objective of CWV optimisation is to attempt to find the optimum set of parameters which provide the best fit, when plotted using regression models, between the CWV and daily demand in each LDZ

- To achieve this, Weather and Demand data - over a suitable period to produce a reasonable estimate of expected Weather conditions during the next seasonal normal cycle - will be sourced from CDSP systems (see further slides)

- This data will form the inputs to an optimisation tool which will modify the parameters and perform regression models between the newly calculated CWV and known 'Aggregate NDM Demand'. For the Seasonal Normal Review cycle which concluded in 2020, the optimisation was achieved by using the 'Solver' function in Microsoft Excel – an iterative 'what-if' analysis tool

- The set of CWV parameters which produce the best relationship over the optimisation trial period will be used in the enduring CWV formula

Scope of CWV Review – Weather Data

- Weather stations:

Table 1 details the weather stations which will be used for optimisation and the resultant CWV definition. DESC will continue to monitor these weather stations and provide an annual update in its July meeting as to their status. As of July 2023 there are no anticipated changes in these weather stations

- Hourly Weightings:

Table 2 details the daily Weighting factors. These Weightings are not being optimised as part of this review cycle, and will therefore be retained for optimisation and the resultant CWV definition

Table 1: Gas Industry Weather Stations

LDZ	Temperature	Windspeed	Solar Radiation
SC	Glasgow Bishopton	Glasgow Bishopton	Glasgow Bishopton
NO	Albemarle Barracks	Albemarle Barracks	Durham Weather Station
NW	Rostherne No 2	Rostherne No 2	Rostherne No 2
NE	Nottingham Watnall	Nottingham Watnall	Nottingham Watnall
EM	Nottingham Watnall	Nottingham Watnall	Nottingham Watnall
WM	Birmingham Winterbourne 2	Coleshill	Coleshill
WN	Rostherne No 2	Rostherne No 2	Rostherne No 2
WS	St. Athan	St. Athan	St. Athan
EA	London Heathrow	London Heathrow	London Heathrow
NT	London Heathrow	London Heathrow	London Heathrow
SE	London Heathrow	London Heathrow	London Heathrow
SO	Southampton Oceanographic Institute	Southampton Oceanographic Institute	Southampton Oceanographic Institute
SW	Yeovilton Weather Station	Yeovilton Weather Station	Yeovilton Weather Station

Table 2: Weather Variable Weightings

Timeslot	05:00	07:00	09:00	11:00	13:00	15:00	17:00	19:00	21:00	23:00	01:00	03:00
Temperature	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.05
Windspeed	0	0.167	0	0.167	0	0.167	0	0.167	0	0.166	0	0.166
Solar Radiation	1	1	1	1	1	1	1	1	1	1	1	1

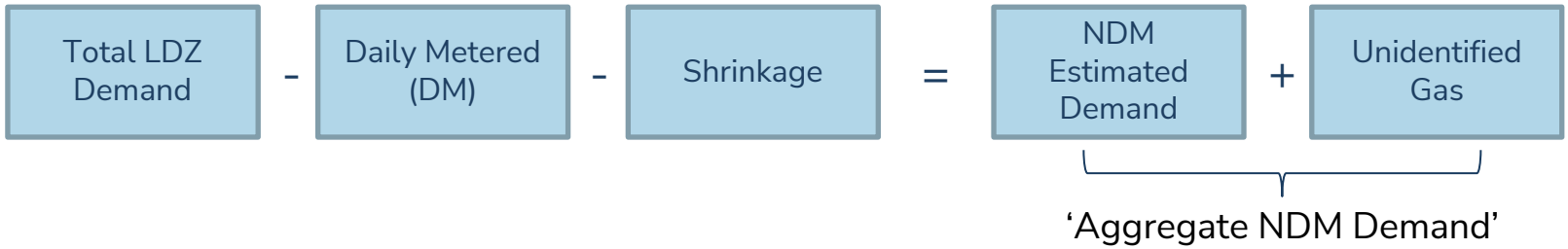
Note: 24 hourly data is being received, all ‘even’ hour slots are weighted at 0

Scope of CWV Review – Demand Data

- The objective in of the CWV formula is to ensure a linear relationship to 'Aggregate NDM Demand' in each LDZ, thus improving the accuracy of NDM Allocation and the reduction of Unidentified Gas (UIG).

- To perform CWV optimisation analysis aggregate NDM demand for the optimisation period is therefore required as a data input.

- 'Aggregate NDM Demand' is calculated as below:



Scope of CWV Review – Data history

- In order to reduce biases caused by exceptional trends in particular Gas Years or periods, it is key to optimise over a suitable history. In 2020, optimisation was performed over an 8 year period (Gas Years 2010/11 to 2017/18 incl.).

- Rolling this forward 5 years would cover Gas Years 2015/16 to 2022/23 which would include the following periods:

  Covid-19 Lockdowns – Analysis performed indicated that Domestic gas usage was not significantly affected by Lockdowns, however there was a noticeable increase in UIG across national lockdowns

  Wholesale Gas Price Changes – During Gas Year 2022/23, Increases in the cost of wholesale gas has led to a drop in End user consumption, subsequent falling of AQs, and negative UIG values.

- The following principles will be maintained when selecting data:

  Gas Days – As previously, optimisation will focus on Monday to Thursday Non Holiday Gas Days

  Metering Errors – Any Gas Days with known Significant LDZ Measurement Errors, such as Thornton Curtis (LDZ EM Apr – Jul 2022), will not be considered

- Do DESC members have any thoughts on whether data affected by Covid-19 lockdowns and gas price increases should form part of CWV optimisation datasets?

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SNCWV REVIEW

Climate Change Methodology

- On 5th July 2023, DESC agreed to proceed with the Met Office to procure a refreshed version of the Climate Change Methodology (CCM)

- CDSP has engaged Met Office who have agreed to complete the refresh of the CCM between January and end of June 2024, in time for the refresh of the Seasonal Normal CWV basis

- Regular updates will be provided to DESC at all 2024 meetings, and a subset of DESC members will have the opportunity to join a stakeholder workgroup to work closely with the CDSP and Met Office to oversee the update of the CCM

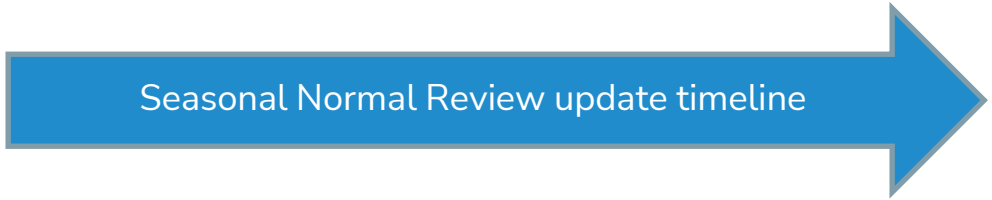
Conclusions

- Unless there are any differing views within DESC, it is recommended that Precipitation is not included in the scope of the CWV formula review

- CDSP will provide an Approach document detailing the steps which will be taken to perform CWV optimisation. We will be seeking DESC's approval at the December DESC meeting

- Work on the refresh of the Climate Change Methodology (CCM) to begin in January 2024

Next Steps



CDSP to provide detailed 'CWV Optimisation approach' document

Oct - Dec 2023

DESC meeting to update on progress and approve Optimisation approach

Dec 2023

Work with Met Office to produce refreshed CCM

Jan - Jun 2024