



## Comprehensive Assessment of the Potential for Efficient Heating and Cooling

Report for Point D Forecast of Demand Trends for Heating and  
Cooling Over the Next 30 Years

Report for Ministry of Energy Commerce and Industry (MECI) of the  
Republic of Cyprus

Report for MECI, Cyprus

ED 14106 | Issue number 1 | Date 22<sup>nd</sup> July 2021

Ricardo Confidential

**Customer:**

Ministry of Energy, Commerce and Industry,  
Cyprus

**Contact:**

Mahmoud Abu Ebid, Gemini Building, Fermi  
Avenue, Harwell, Didcot, OX11 0QR, UK

**Customer reference:** YEEB/YE/01/2020

**T:** +44 (0) 1235 753193

**E:** mahmoud.abu-ebid@ricardo.com

**Confidentiality, copyright and reproduction:**

*This report is the Copyright of the Ministry of Energy, Commerce and Industry, Cyprus and has been prepared by Ricardo Energy & Environment, a trading name of Ricardo-AEA Ltd under contract Comprehensive Assessment of the Potential for Efficient Heating and Cooling dated 13<sup>th</sup> October 2021. The contents of this report may not be reproduced, in whole or in part, nor passed to any organisation or person without the specific prior written permission of the Ministry of Energy, Commerce and Industry, Cyprus. Ricardo Energy & Environment accepts no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this report, or reliance on any views expressed therein, other than the liability that is agreed in the said contract.*

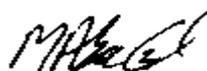
**Author:**

Richard Hodges

**Approved by:**

Mahmoud Abu Ebid

**Signed**



**Date:**

22<sup>nd</sup> July 2021

**Ref:** ED14106

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

# Table of Contents

<b>Table of Contents .....</b>	<b>iii</b>
<b>1 Introduction.....</b>	<b>1</b>
<b>2 Final Energy Demand, Primary Energy Supply and Carbon Emissions .....</b>	<b>2</b>

# 1 Introduction

Annex VIII of the Energy Efficiency Directive 2012/27/EU requires that the comprehensive assessment of national heating and cooling potentials includes a forecast of trends in the demand for heating and cooling to maintain a perspective for the next 30 years. It goes on to say that the projections should particularly take into account projections for the next 10 years, the change in demand in buildings and industry and the impact of policies and strategies related to heating and cooling.

Pursuant to this requirement, we have used the “With Existing Measures” (WEM) projection of Final Energy Demand (FED) for heating and cooling set out in the 2020 National Energy and Carbon Plan (NECP) and the NECP Impact Assessment. Projections are made each year to 2030 and then every 5 years to 2050. As required by Annex VIII, these projections have factored in the anticipated impact of policies, measures and strategies on the demand for heating and cooling out to 2050.

We have further made projections of the effect of this FED on Primary Energy Supply (PES) for heating and cooling using projections of fuel splits, including projections for primary energy supply to electricity generation for the same period. This has allowed us to associate primary energy with the final electricity used for the generation of heating and cooling. This gives a full picture of the primary energy inputs to meet heating and cooling demand and helps inform any security of supply issues which might arise in the future.

Finally, using the aforementioned FED fuel split and projections of the fuel split into electricity generation, including the considerable near term shift from oil to natural gas for electricity generation and the near and long term shift to renewable electricity, we have been able to project the CO<sub>2e</sub> emissions associated with the heating and cooling demand out to 2050.

In the sections below we present these projections, first for the whole economy and then by sector.

## 2 Final Energy Demand, Primary Energy Supply and Carbon Emissions

Table 1 and Figure 1 below shows the WEM scenario projected final energy demands by energy type from 2021 to 2050 based on data in the NCEP Impact Assessment, Deliverable 5, plus the situation in 2018 as determined under Point A of the current work. This is the projection for heating and cooling across the whole economy.

In developing these projections, it should be noted that the Impact Assessment (IA) and the NCEP itself do not provide values for the ambient heat captured by heat pumps. However, consistent with the fuel split given in the National Energy Balance, this has been included in the breakdown given in Point A. To make the projections presented here consistent with Point A, it has been necessary to calculate the quantity of ambient heat from the tables given in the NECP and IA. To do this we have used the observation that the calculation of the percentage RES in the NCEP tables (e.g. Table 5.4 in the NECP) includes ambient heat in the numerator and denominator, but electricity is excluded from the denominator; i.e.:

$$\text{RES share (NCEP tables)} = \frac{\text{Biomass} + \text{Geothermal} + \text{Solar thermal} + \text{Ambient heat}}{\text{Total (incl. Ambient heat)} - \text{Electricity}}$$

Using this relationship has allowed us to calculate the FED that is ambient heat captured by heat pumps for each year of the projection.

The equivalent data for primary energy supply are presented in Table 2 and Figure 2, and for carbon emissions in Table 3 and Figure 3 – again for the whole economy. These have also been determined from data in the NCEP Impact Assessment, Deliverable 5, plus the situation in 2018 as determined under Point A. The emissions factor for delivered electricity has been determined from the projected WEM fuel mix for each year and is also shown in Table 3.

Indices for the three parameters are shown together for comparison in Figure 4.

Figure 5 to Figure 7 give the projections for FED, PES and CO<sub>2e</sub> emissions, respectively, associated with the residential, service, industry and agriculture sectors.

Table 2-1 Final energy demand (FED) of the heating and cooling sector (PJ) – WEM scenario

	2018	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Electricity	6.68	7.83	8.12	8.30	8.51	8.69	8.91	9.14	9.38	9.64	9.79	10.42	10.87	11.31	11.71
Other oil products	7.99	6.88	6.83	6.70	6.67	6.69	6.70	6.69	6.68	6.65	6.62	6.06	5.74	4.99	4.24
Pet Coke	2.33	3.16	2.95	2.74	2.58	2.49	2.41	2.33	2.26	2.18	2.13	1.92	1.72	1.58	1.47
LPG	1.40	2.61	2.60	2.56	2.57	2.61	2.65	2.70	2.74	2.78	2.82	2.81	2.69	2.48	2.19
Biomass	2.22	1.04	1.02	0.99	1.04	1.10	1.16	1.21	1.25	1.29	1.33	1.44	1.63	1.65	1.63
Geothermal	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.07	0.09	0.14	0.21
Solar thermal	2.93	3.01	3.03	3.03	3.11	3.20	3.29	3.40	3.51	3.63	3.75	4.77	5.99	7.09	8.2
HP ambient heat	1.93	2.01	2.04	2.07	2.10	2.13	2.16	2.19	2.23	2.24	2.27	2.41	2.56	2.69	2.85
<b>Total</b>	<b>25.55</b>	<b>26.60</b>	<b>26.65</b>	<b>26.45</b>	<b>26.64</b>	<b>26.97</b>	<b>27.34</b>	<b>27.71</b>	<b>28.10</b>	<b>28.46</b>	<b>28.76</b>	<b>29.90</b>	<b>31.29</b>	<b>31.93</b>	<b>32.50</b>
<b>RES share</b>	<b>30.4%</b>	<b>32.6%</b>	<b>33.2%</b>	<b>33.9%</b>	<b>34.8%</b>	<b>35.5%</b>	<b>36.2%</b>	<b>36.9%</b>	<b>37.6%</b>	<b>38.3%</b>	<b>39.0%</b>	<b>44.6%</b>	<b>50.3%</b>	<b>56.1%</b>	<b>62.0%</b>
FED index (2018 = 100)	100.00	104.10	104.31	103.54	104.26	105.55	107.01	108.46	109.97	111.37	112.55	117.01	122.47	124.95	127.19

Derived from: Point A and Tables 14 and 54 of the NCEP Impact Assessment Deliverable 5

Figure 1 Final energy demand (FED) of the heating and cooling sector (PJ) – WEM scenario

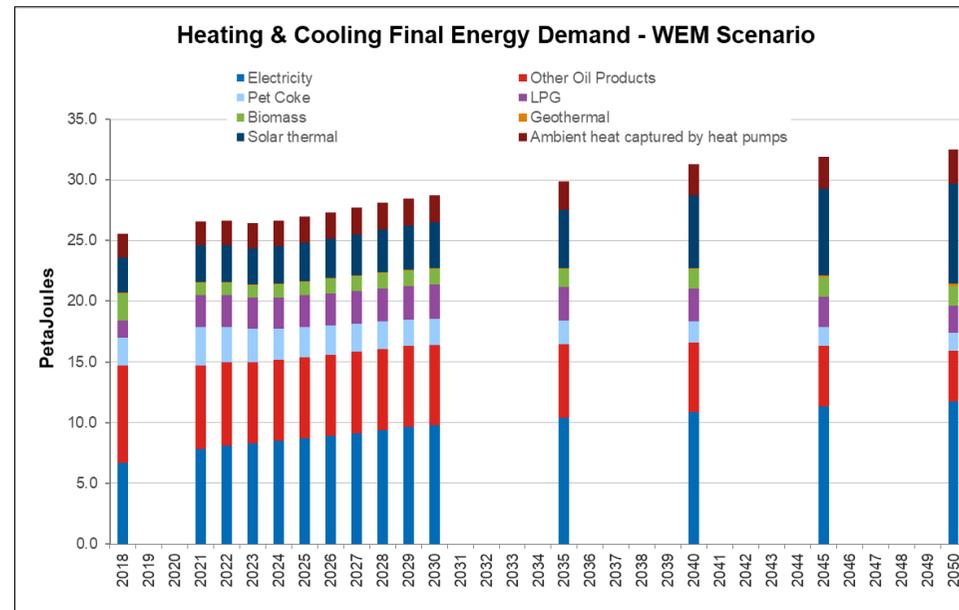


Table 2-2 Primary energy supply (PES) for the heating and cooling sector (PJ) – WEM scenario

	2018	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Fuel for power generation	17.91	18.07	16.45	16.82	15.98	16.31	16.38	16.72	17.25	17.78	18.09	14.43	11.25	9.53	8.47
Other oil products	7.99	6.88	6.83	6.7	6.67	6.69	6.7	6.69	6.68	6.65	6.62	6.06	5.74	4.99	4.24
Pet Coke	2.33	3.16	2.95	2.74	2.58	2.49	2.41	2.33	2.26	2.18	2.13	1.92	1.72	1.58	1.47
LPG	1.40	2.61	2.6	2.56	2.57	2.61	2.65	2.7	2.74	2.78	2.82	2.81	2.69	2.48	2.19
Biomass	2.22	1.04	1.02	0.99	1.04	1.1	1.16	1.21	1.25	1.29	1.33	1.44	1.63	1.65	1.63
Geothermal	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.07	0.09	0.14	0.21
Solar thermal	2.93	3.01	3.03	3.03	3.11	3.2	3.29	3.4	3.51	3.63	3.75	4.77	5.99	7.09	8.2
HP ambient heat	1.93	2.01	2.04	2.07	2.10	2.13	2.16	2.19	2.23	2.24	2.27	2.41	2.56	2.69	2.85
<b>Total</b>	<b>36.78</b>	<b>36.84</b>	<b>34.98</b>	<b>34.98</b>	<b>34.11</b>	<b>34.59</b>	<b>34.82</b>	<b>35.30</b>	<b>35.97</b>	<b>36.60</b>	<b>37.06</b>	<b>33.91</b>	<b>31.67</b>	<b>30.15</b>	<b>29.26</b>
PES index (2018 = 100)	100.00	100.15	95.11	95.10	92.74	94.03	94.66	95.97	97.80	99.51	100.76	92.20	86.12	81.97	79.56

Derived from: Point A and Tables 15, 16, 55 and 56 of the NCEP Impact Assessment Deliverable 5

Figure 2 Primary energy supply (PES) for the heating and cooling sector (PJ) – WEM scenario

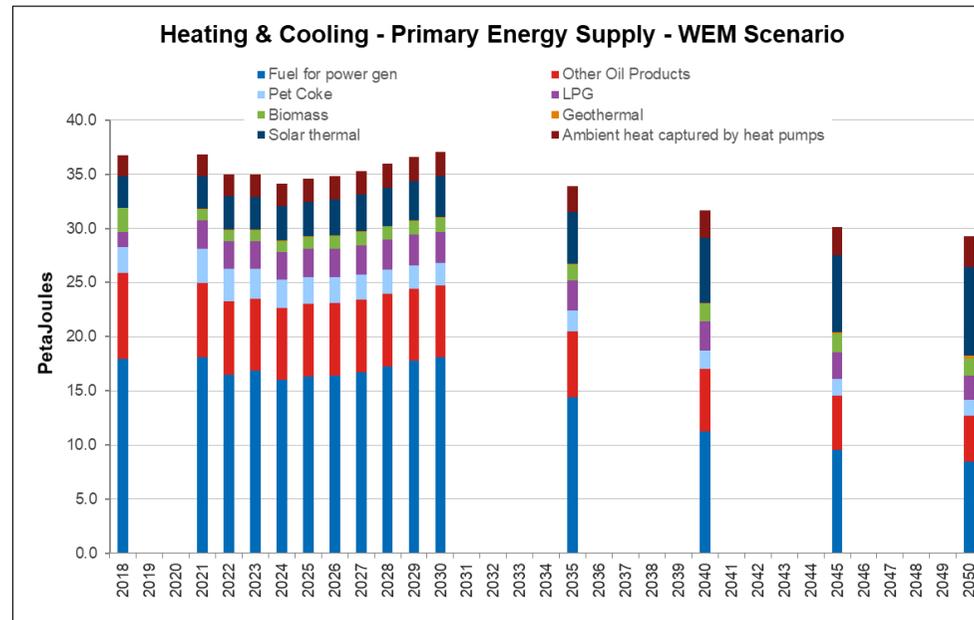


Table 2-3 Carbon dioxide equivalent emissions for the heating and cooling sector (ktCO<sub>2e</sub>) – WEM scenario

	2018	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
All fuels	2,339	2,287	1,867	1,845	1,747	1,752	1,720	1,725	1,748	1,770	1,782	1,424	1,207	1,036	876
CO <sub>2e</sub> emissions index (2018 = 100)	100.00	97.75	79.79	78.88	74.67	74.89	73.52	73.73	74.74	75.68	76.16	60.86	51.58	44.31	37.43

CO <sub>2e</sub> emissions factor for delivered electricity (tCO <sub>2e</sub> /PJ)	204,942	159,440	105,162	104,402	92,334	91,547	86,206	85,183	86,058	86,821	87,132	53,906	36,596	27,898	20,898
---	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Figure 3 Carbon dioxide equivalent emissions for the heating and cooling sector (ktCO<sub>2e</sub>) – WEM scenario

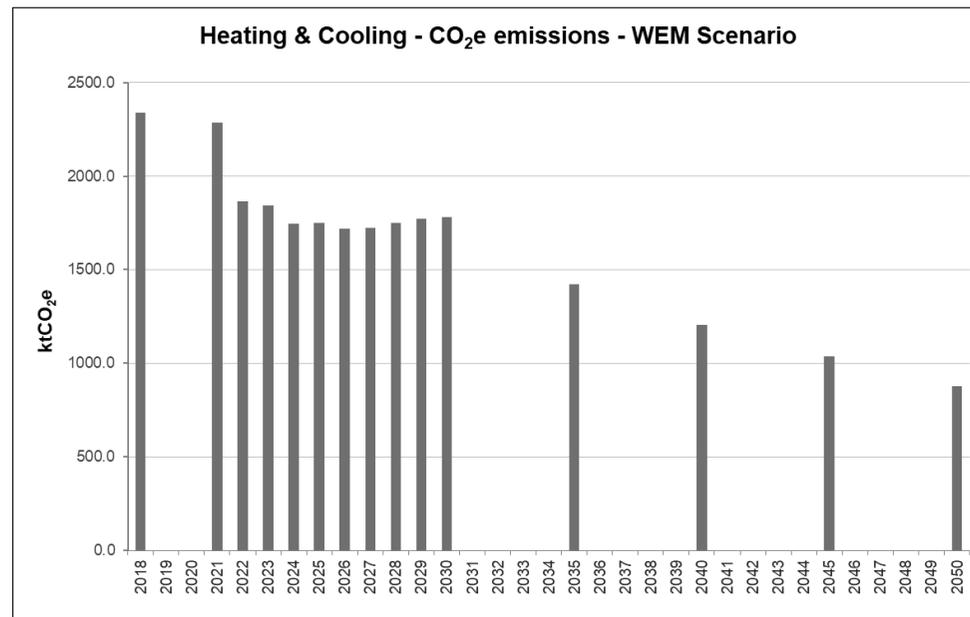


Figure 4 Carbon dioxide equivalent emissions for the heating and cooling sector (ktCO<sub>2e</sub>) – WEM scenario

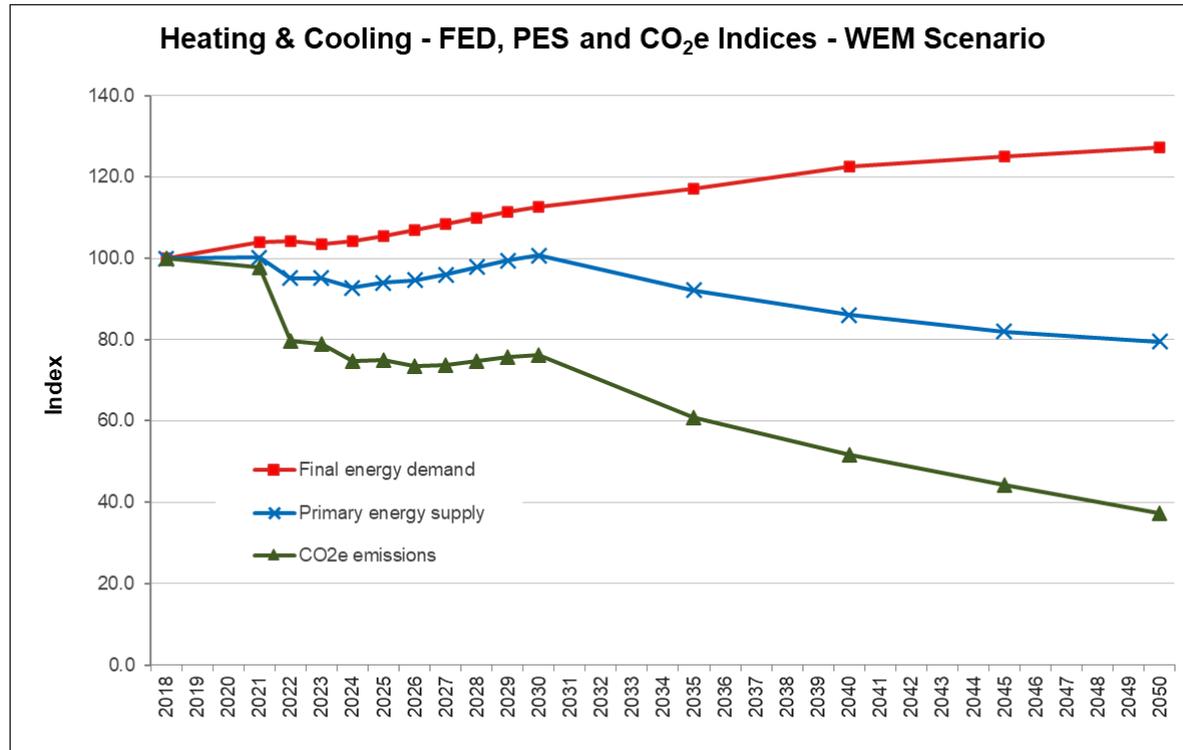


Figure 5 Sectoral (FED) of the heating and cooling sector (PJ) – WEM scenario

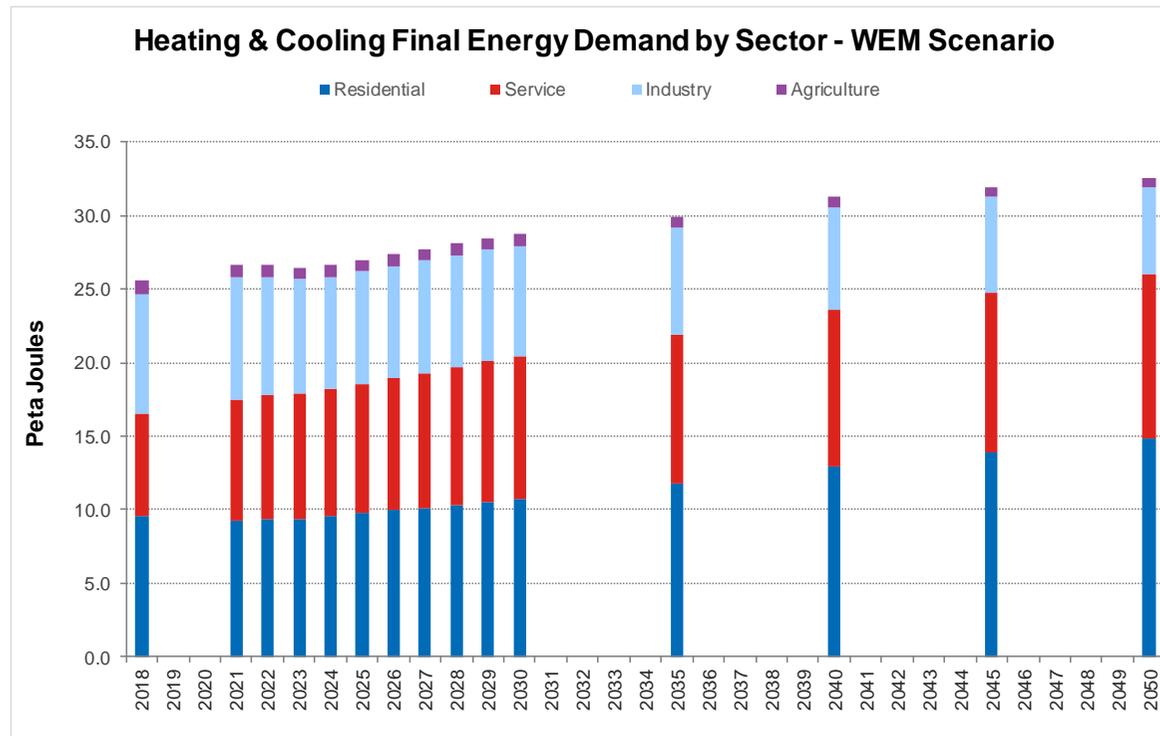


Figure 6 Sectoral (PES) for the heating and cooling sector (PJ) – WEM scenario

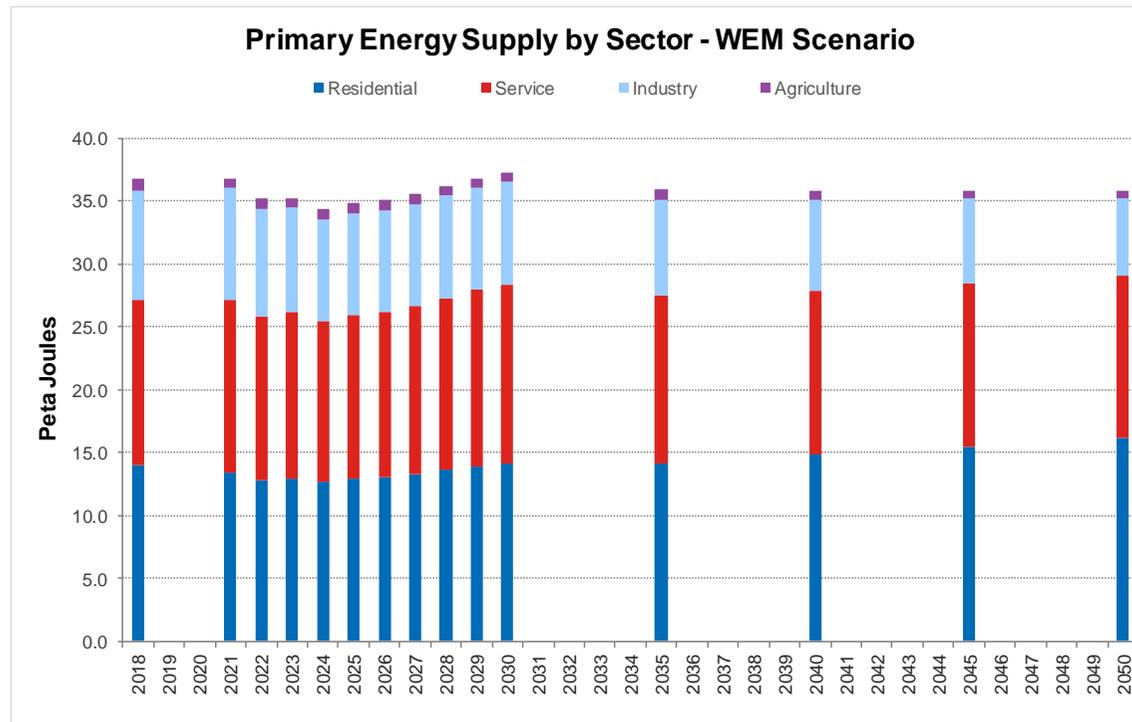
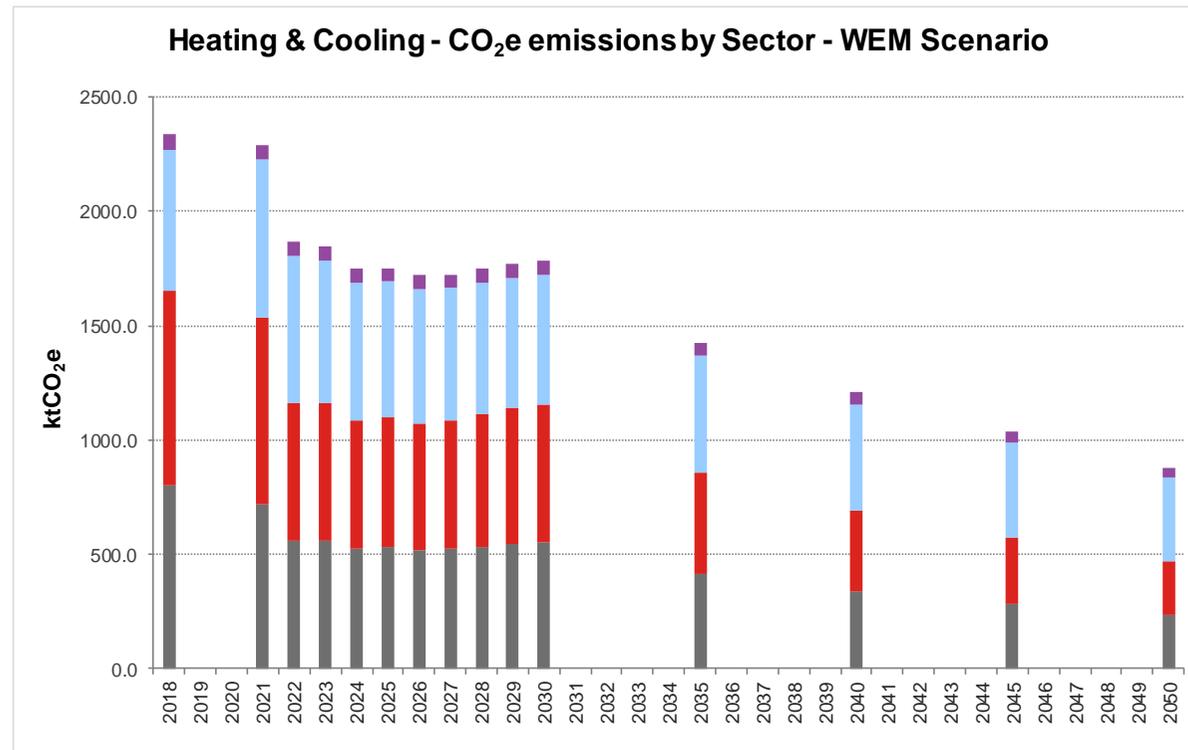


Figure 7 Sectoral carbon dioxide equivalent emissions for the heating and cooling sector (ktCO<sub>2e</sub>) – WEM scenario





T: +44 (0) 1235 753000

E: [enquiry@ricardo.com](mailto:enquiry@ricardo.com)