VITAL ENERGI UTILITIES LIMITED

BICESTER ECO DEVELOPMENT
AIR QUALITY ASSESSMENT

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Revision History			
Revision	**Date**	**Page(s) Affected**	**Description**
P1	04/03/13	All	Initial Issue
P2	16/08/13	All	Amended to exclude commercial
P3	11/09/2015	All	Updated to include 500mg/m3 engine

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1 EXCUTIVE SUMMARY

Vital Energi Utilities Ltd. (VEUL) has previously conducted a local air quality impact assessment for the proposed energy centre at Bicester Eco Village, Oxfordshire. The proposed energy centre comprises of one combined heat and power (CHP) unit and five boilers for future phases, all using natural gas as fuel. One of the boilers is intended for backup use only.

The aim of the assessment was to evaluate the potential impacts of the emissions from the energy centre on ambient air quality, in relation to the objectives and limit values set out in the UK National Air Quality Strategy and EU Air Quality Directives.

Since the second revision of this AQA was released in August 2013, a number of changes have been made to the scheme which have been captured and included in this third version:

- *Urban background & roadside emissions updated in line with the most current Cherwell District Council North Oxfordshire Air Quality Progress Report 2013 & 2014*
- *Latest DEFRA background pollution maps*
- *Changed the configuration of the CHP engine from 250mg/m^3 to 500mg/m^3*

The overall conclusion of this latest assessment is that, as per the previous report, with a flue stack height of 12m for the 393 dwelling phase and 17m for the 1100 dwellings phase, there are no new exceedences of air quality objectives predicted.

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2 INTRODUCTION

2.1 Background

2.1.1 Due to changes in the CHP emissions used in the original air quality report, an update has been undertaken to ensure local air quality is not adversely affected. Due to the time gap between the original report and this update the latest air quality information available has been used and the model updated to include this.

2.2 Scope

2.2.1 The scope is as per the original report.

2.2.2 The development is proposed to have 393 dwellings built by 2017 and then a further 1100 units by 2022. The following boilers and engines are proposed for the energy centre development:

393 Dwelling Phase

- 1 x CHP gas engine of 889kW$_e$/913kW$_{th}$
- 1 x Condensing gas boiler 1.7MW (2 Modules Duty/Duty)
- 1 x HE gas boiler 1.75MW (Standby)

1100 Dwelling Phase

- 1 x CHP gas engine of 889kW$_e$/913kW$_{th}$
- 1 x Condensing gas boiler 1.7MW(2 Modules Duty/Duty)
- 3 x HE gas boiler 3.5 MW (Duty/Duty/Standby)

2.2.3 VEUL have been provided with energy profiles from SSE (the operator of the EC). From the load profiles emission factors have been derived for the CHP and boilers. These are shown in Figures 7 to 12 contained within Appendix B. These represent the most credible operating scenario for the energy centre which meets the expected annual energy demands of the development.

3 METHODOLOGY

3.1 Dispersion Modelling

3.1.1 The methodology used in the assessment was based on a dispersion model of the emissions from the energy centre. The model was able to predict the energy centre contribution to ambient pollution concentrations at potential receptors in the vicinity of the development, both at ground level and at the façades of the upper floors of buildings. This is in line with the original report and there has been no change in the receptors.

3.1.2 For the assessment of hourly average pollutant concentrations, the relevant scenario is based on the full load operation of the CHP engine and 2No. Condensing boilers operating at full load and the HE boiler acting as standby for the 393 dwelling phase. As the energy centre demand increases during the 1100 dwelling phase 2, 2No. HE boilers come online. As noted in section 2.2.2, HE boiler No.3 is used as a standby boiler as the development progresses to 1100 dwellings.

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3.1.3 The model included all significant buildings in the vicinity of the development site at their maximum height (at the eaves), including the residential blocks to the North East and East of the energy centre and including the commercial buildings for downwash during phase 2.

3.1.4 The model results are presented for the energy centre stack modelled at a height of 12m for the 393 dwelling phase and 17m for 1100 dwellings phase. This height was determined by previous air quality assessments. This is the lowest height providing acceptable impacts at ground level and at the façades of nearby buildings.

3.2 Background Pollutant Concentrations

3.2.1 Background pollution levels refer to the pollutant concentrations in ambient air in the absence of the development under consideration. There is no air quality monitoring data available for the site, but the DEFRA background pollutant maps demonstrates the background annual mean nitrogen dioxide pollutant concentrations at the site is currently around 11.4µg/m^3. However Tamarisk Gardens has been selected as the Urban Background as this monitoring station is a closer representation of the intended development conditions once construction has been completed.

3.2.2 Since the last issue of the AQA, DEFRA has updated the coordinate system on their background pollutant maps, the coordinates now use figures rounding to the nearest 100m. The DEFRA background concentration pollutant map has increased from 9.7µg/m^3 to 11.4µg/m3 in 2013

3.2.3 Looking at the surrounding area of the development, this relatively low background concentration seems appropriate as the south westerly wind travels over land mainly restricted to agricultural practices. This is well within the air quality objective for nitrogen dioxide (40µg/m^3 as an annual mean).

3.2.4 Pollutant concentrations are likely to fall in the future, however recent levels of nitrogen dioxide have been measured above the air quality objective in Queens Avenue. Cherwell District Council has indicated that further assessment is to be carried out to determine if an AQMA will be implemented.

Station	Easting	Northing	Distance to Site (m)	Annual Mean Nitrogen Dioxide					In an AQMA ?	Range in 2013
				2009	2010	2011	2012	2013		
Roadside Monitoring Sites										
Queens Avenue	458028	222471	2300	44.1	46	42.9	45	41	N	37.1-41
Market Square	458589	222340	2500	31.7	37.2	35.7	45.6	37.1	N	
Urban Background Monitoring Sites										
Tamarisk Gardens	458404	224332	630	19.7	22.3	22.3	17.6	17.4	N	11.4-17.4
DEFRA Background	458500	225500	892	10.2	12.1	12.1	11.8	11.4	N	

Table 1: Cherwell District Council air quality monitoring for nitrogen dioxide (µg/m3) within the study area

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3.3 Assessment of Significance

3.3.1 The consideration of whether the impact of emissions from the energy centre is significant depends on the magnitude of the impact, the importance of the affected receptors, and the background pollution levels. Even a small impact on a valuable receptor, such as a residential property, may be considered significant, particularly where background pollution levels are already high.

3.4 Long Term Annual Concentrations

3.4.1 Whilst there are no universally accepted criteria for assessing the significance of air quality impacts, for this assessment VEUL have adopted the criteria proposed by Environment Protection UK as shown in Table 2 and Table 3.

3.4.2

Magnitude of Change	Pollution Concentration Change
Large	Increase/decrease >10%
Medium	Increase/decrease 5 – 10%
Small	Increase/decrease 1-5%
Imperceptible	Increase/decrease <1%

Table 2: Definition of impact magnitude as a percentage of the objective

Total Pollutant Concentration including Process Contribution	Change in Concentration			
	Imperceptible	Small	Medium	Large
Above Objective	Negligible	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective (>90%)	Negligible	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective (>75%)	Negligible	Negligible	Slight Adverse	Slight Adverse
Well Below Objective (<75%)	Negligible	Negligible	Negligible	Slight Adverse

Table 3: Air quality impact descriptors for an increase in pollutant concentration at a receptor

3.5 Short Term Annual Concentrations

3.5.1 Whilst there are no universally accepted criteria for assessing the significance of short term air quality impacts, for this assessment VEUL have adopted the criteria proposed by the Environment Agency in H1 Annex F Air Emissions.

3.5.2 In line with the Environment Agency guidance process contributions can be considered insignificant if:

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- The long term process contribution is <1% of the long term environmental standard
- The short term process contribution is <10% of the short term environmental standard

4 RESULTS

4.1 Maximum Ground Level Concentrations

4.1.1 The maximum process contributions to ground level concentrations are shown overleaf, in Table 4, for all meteorological years.

4.1.2 Figures 2, 3, 4 and 5 in Appendix B show the spatial distribution of annual mean concentrations of nitrogen dioxide for 2010, and hourly mean concentrations for 2008. These are the years which produce the highest ground level concentrations for these metrics, but other years show similar spatial distribution.

4.1.3 Annual mean concentrations are at a maximum 10 metres to the south east of the stack for the 393 dwelling phase & 1100 dwelling phase. The occurrence of this high annual mean concentration is most likely due to pollutant downwash at times of atmospheric stability. Figure 6 in Appendix B shows the wind roses for 2007 to 2011 for the nearest meteorological station, Benson.

4.1.4 For assessment against the hourly mean air quality objective for nitrogen dioxide, which allows 18 exceedances of the 200µg/m^3 standard, the process contribution to hourly mean concentrations is reported as the 99.79th percentile of hourly mean concentrations over single meteorological years. This percentile is equivalent to the 18th highest hourly mean concentration in each year.

4.1.5 Figure 3 & 5 in Appendix B shows that maximum hourly mean concentrations of nitrogen dioxide occur 50m north of the stack. This is a consequence of the Eco Business Units being at a similar height to the stack.

4.1.6 Inter-annual variation in the annual mean concentrations for the 393 dwellings is relatively high, at +/-20.4 % about the mean, decreasing very slightly as the averaging period changes to +/-18.3% for the hourly mean concentrations. Inter-annual variation in the annual mean concentrations for the 1100 dwellings is relatively high, at +/-14.9% about the mean, increasing as the averaging period decreases to +/-22.8% for the hourly mean concentrations. The meteorological year resulting in the highest concentrations varies between averaging periods, but overall 2009-2010 are the worst years for annual mean concentrations and 2008 is the worst year for hourly mean concentrations.

4.1.7 The magnitude of the impact of the energy centre on ground level ambient particulate matter concentrations is assumed imperceptible and not included in the dispersion model due to the use of natural gas as the fuel source.

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4.1.8 The magnitude of the impact of the energy centre on annual mean nitrogen dioxide concentrations is moderate (5-10% of the objective) for all meteorological years. The location of the maximum impact on the annual mean pollutant concentrations lies to the south east of the stack, within 10m. Consequently, background concentrations of nitrogen dioxide at the point of maximum impact are likely to be elevated but still well below the air quality objective.

Objective	393 Dwellings				1100 Dwellings			
	Annual Mean		Hourly Mean (as 99.79th percentile)		Annual Mean		Hourly Mean (as 99.79th percentile)	
	40µg/m³		200 µg/m³		40µg/m³		200 µg/m³	
Year	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.
2007	2.92	7.3%	26.78	13.4%	3.30	8.3%	22.09	11.0%
2008	2.65	6.6%	30.40	15.2%	3.65	9.1%	23.92	12.0%
2009	2.50	6.3%	25.88	12.9%	3.70	9.3%	18.47	9.2%
2010	3.14	7.9%	24.84	12.4%	3.25	8.1%	19.77	9.9%
2011	2.92	7.3%	27.54	13.8%	3.82	9.5%	20.42	10.2%

Table 4: Maximum process contribution to ground level pollutant concentrations for the most likely operating scenarios, provided as a function of meteorological year

4.1.9 The magnitude of the impact of the energy centre on hourly mean nitrogen dioxide concentrations is large (>10% of the objective) for most meteorological years. The location of the maximum impact on the annual mean pollutant concentrations lies at the façade of the flat buildings 343-348 located around 40m east of the stack. Background concentrations for the assessment of hourly mean nitrogen dioxide in the area are likely to be well below the air quality objective.

4.2 Ground Level Concentrations at the Roadside

4.2.1 Section 4.1 above considered the maximum impact of the energy centre on pollutant concentrations at any ground level location within the study area. The point of maximum impact occurs at a location distant from major roads and, therefore, the cumulative impact of existing emission sources and the energy centre may be greater at the roadside.

4.2.2 The maximum impact of the energy centre for 393 dwellings occurs at a roadside location to the east of the stack, on the B4100, where the process contribution to annual mean nitrogen dioxide concentrations is 0.32µg/m^3 or less (<1% of the environmental objective, an imperceptible impact). The maximum impact on hourly mean concentrations is insignificant, 6.88µg/m^3 which is less than 10% of the hourly objective. The process contribution to annual mean dioxide concentrations for the 1100 dwellings is 0.53 µg/m^3 or less (<1% of the objective, an insignificant impact). The maximum impact on hourly mean concentrations for this phase is 8.7µg/m^3 which is insignificant, at less than 10% of the objective.

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Objective	393 Dwellings				1100 Dwellings			
	Annual Mean		Hourly Mean (as 99.79th percentile)		Annual Mean		Hourly Mean (as 99.79th percentile)	
	40µg/m³		200 µg/m³		40µg/m³		200 µg/m³	
Year	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.
2007	0.32	0.8%	6.72	3.4%	0.53	1.3%	8.7	4.3%
2008	0.23	0.6%	5.18	2.6%	0.38	<1%	7.4	3.7%
2009	0.24	0.6%	5.67	2.8%	0.38	<1%	7.5	3.7%
2010	0.30	0.8%	6.88	3.4%	0.45	1.1%	8.5	4.3%
2011	0.20	0.5%	5.27	2.6%	0.35	<1%	6.6	3.3%

Table 5: Maximum process contribution to ground level pollutant concentrations at the closest roadside for the most likely operating scenarios, provided as a function of meteorological year

4.3 Concentrations at Building Façades

4.3.1 There are a number of tall buildings in the vicinity of the energy centre which could be affected by the plume from the energy centre stack. Table 6 shows the maximum impact of the energy centres on pollutant concentrations at the building façades.

4.3.2 The highest annual mean concentrations during the 393 dwellings phase occur to north of the stack on the shared ownership apartments (S5) at second floor level. This building is in the vicinity of the stack (~40m), and the concentration of nitrogen dioxide can be attributed to the downwash effect. The highest annual mean concentration during the 1100 dwelling phase occurs at the office building (S2) at ground level. This building is in the immediate vicinity of the stack (~6m) and the concentration of nitrogen dioxide can be attributed to the downwash effect.

4.3.3 The maximum contribution during the 393 dwelling phase of the energy centre to annual mean nitrogen dioxide concentrations at the shared ownership apartments (S5) is less than 2.39µg/m^3 and a medium impact (5-10% of the objective). With background concentrations well below the objective, this is a negligible impact. The maximum contribution during the 1100 dwelling phase of the energy centre to annual mean nitrogen dioxide concentrations at the office building (S2B) is less than 3.8µg/m^3 and a medium change (5-10% of the objective). With background concentrations well below the objective, this is a negligible impact.

4.3.4 The maximum impact during the 393 dwelling phase on hourly mean concentrations occurs at the shared ownership apartments (S5) at second floor level, where the magnitude of the impact is large. There are no new exceedances of the objective modelled and, with pollutant concentrations likely to remain well below the air quality objective. The maximum impact during the 1100 dwelling phase on hourly mean concentrations occurs at the office building (S2B), where the magnitude of the impact is moderate. There are no new exceedances of the objective

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modelled and, with pollutant concentrations likely to remain well below the air quality objective.

4.3.5 The magnitude of the maximum impact during the 393 dwelling phase of the energy centre on hourly mean concentrations at S5 is 35.7 µg/m^3 (>10% of objective). There are no new exceedances of the objective modelled and pollutant concentrations are likely to remain within the air quality objective. The magnitude of the maximum impact during the 1100 dwelling phase of the energy centre on hourly mean concentrations at S2B is 20.0 µg/m^3 (10% of objective). There are no new exceedances of the objective modelled and pollutant concentrations are likely to remain within the air quality objective.

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Receptors	393 Dwellings				1100 Dwellings			
	Annual Mean		Hourly Mean (as 99.79th percentile)		Annual Mean		Hourly Mean (as 99.79th percentile)	
	40µg/m3		200µg/m3		40µg/m3		200µg/m3	
	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.	µg/m3	% of obj.
S1A	Not constructed during 393 dwelling phase				0.44	1.1	14.3	7.1
S1B					0.72	1.8	17.0	8.5
S2					0.62	1.5	11.5	5.8
S2A					2.55	6.4	19.8	9.9
S2B					3.80	9.5	20.0	10.0
S3					0.55	1.4	10.7	5.4
S3A					0.37	0.9	8.7	4.4
S3B					0.33	0.8	12.0	6.0
S4	1.47	3.68	22.7	11.3	0.46	1.16	17.5	6.8
S4A	0.76	1.89	20.1	10.0	0.45	1.13	17.5	6.8
S4B	0.52	1.31	19.3	9.6	0.38	0.94	17.1	5.9
S5	2.39	5.98	35.7	17.8	0.41	1.02	15.0	6.4
S5A	1.59	3.98	21.2	10.6	0.33	0.84	13.5	6.1
S5B	1.22	3.05	19.2	9.6	0.24	0.60	10.7	5.6
S6	1.64	4.09	23.4	11.7	0.93	2.32	19.2	9.1
S6A	1.63	4.08	23.4	11.7	0.93	2.32	19.2	9.1
S6B	1.52	3.80	23.4	11.7	0.93	2.32	19.2	9.1
S7	Not constructed during 393 dwelling phase				0.49	1.22	13.6	7.0
S7A					0.30	0.76	10.8	5.9
S7B					0.22	0.56	9.0	5.5
S8	1.42	3.55	21.5	10.8	0.78	1.95	15.0	6.7
S8A	1.38	3.45	20.8	10.4	0.70	1.74	14.8	6.6
S8B	1.37	3.43	20.8	10.4	0.69	1.71	14.8	6.7
Queens Avenue	0.01	0.02	0.2	0.1	0.01	0.02	0.2	0.1
TarmariskGardens	0.04	0.09	1.1	0.6	0.04	0.10	1.3	0.7
Market Square	0.01	0.01	0.2	0.1	0.01	0.01	0.2	0.1
Defra Background	0.03	0.07	0.5	0.3	0.03	0.08	0.7	0.6
B4100	0.32	0.81	6.7	3.4	0.34	0.86	7.0	3.7
A4421	0.01	0.02	0.2	0.1	0.01	0.03	0.3	0.3
S9	Not constructed during 393 dwelling phase				0.73	1.8	13.0	6.5
S10 0m a					1.06	2.6	13.3	6.7
S10 6m a					1.20	3.0	13.3	6.7
S10 9m a					1.56	3.9	12.1	6.0
S10 0m b					0.89	2.2	12.3	6.1
S10 6m b					1.06	2.7	12.9	6.5
S10 9b					1.49	3.7	13.3	6.6

Table 6: Maximum process contribution to ground level pollutant concentrations at building façades for the most likely scenarios, provided as a function of meteorological year

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5 CONCLUSIONS

5.1 Nitrogen Dioxide

5.1.1 The modelling has considered scenarios in which the energy centre is operating at realistic average and peak emissions. The modelled scenarios represent the most credible operating scenarios for the plant.

5.1.2 The maximum impacts of the Energy Centre at ground level concentration are of negligible significance on ground level concentrations.

5.1.3 At the façades of the tall buildings (S2 & S5) in the vicinity of the energy centre, the magnitude of the impacts of the energy centre emissions is negligible for long term pollutant concentrations and negligible to slight adverse for short term concentrations. However, taking into account the low background concentrations at these locations, no exceedances of the air quality objectives are predicted as a result of the operation of the energy centre. Therefore, the impacts are of negligible to slight adverse significance.

5.1.4 It should be borne in mind that the assessment of impacts at the point of maximum impact of the plume and at the façades of the tall buildings is conservative. For short averaging periods, this conservatism is largely due to the neglect of the effects of the enhanced dispersion of pollutants around the building by an increase in turbulence when the wind blows directly from the stack towards the building. A summary of the assessment of the significance of impacts is shown in Table 7 & 8 below.

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393 Dwellings						
Location	**Future Baseline Concentration**	**Impact**	**Descriptor**	**Total Concentration**	**Descriptor**	**Significance**
	Annual Mean Pollutant Concentrations					
Point of Maximum Ground Level Impact	17.4 µg/m^3	< 3.14 µg/m^3 (5-10%)	Medium	< 20.54 µg/m^3	Well Below Objective	Negligible
Maximum Roadside Impact	41µg/m^3	< 0.32 µg/m^3 (< 1%)	Imperceptible	< 41.32 µg/m^3	Above Objective	Negligible
Maximum Impact on Building S5 Facade	17.4 µg/m^3	< 2.39 µg/m^3 (5-10%)	Medium	< 19.79 µg/m^3	Well Below Objective	Negligible
	Hourly Mean Pollutant Concentrations					
Point of Maximum Ground Level Impact	34.8 µg/m^3	< 30.4 µg/m^3 (>10%)	Large	< 65.2 µg/m^3	Well Below Objective	Slight Adverse
Maximum Roadside Impact	82µg/m^3	< 6.88 µg/m^3 (1-5%)	Small	< 88.88 µg/m^3	Well Below Objective	Negligible
Maximum Impact on Building S5 Facade	34.8 µg/m^3	< 35.7 µg/m^3 (>10%)	Large	< 70.5 µg/m^3	Well Below Objective	Slight Adverse

Hourly concentration assumed = 2 x annual mean background concentration for assessment of short term impacts

Table 7: Summary of assessment of significance of impacts for nitrogen dioxide for the 393 dwelling phase

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1100 Dwellings						
Location	Future Baseline Concentration	Impact	Descriptor	Total Concentration	Descriptor	Significance
	Annual Mean Pollutant Concentrations					
Point of Maximum Ground Level Impact	17.4 µg/m^3	< 3.7 µg/m^3 (5-10%)	Medium	< 21.11 µg/m^3	Well Below Objective	Negligible
Maximum Roadside Impact	41µg/m^3	< 0.53 µg/m^3 (< 1%)	Imperceptible	< 41.53 µg/m^3	Above Objective	Negligible
Maximum Impact on Building S2 Façade	17.4 µg/m^3	< 3.8 µg/m^3 (5-10%)	Medium	< 21.2 µg/m^3	Well Below Objective	Negligible
	Hourly Mean Pollutant Concentrations					
Point of Maximum Ground Level Impact	34.8 µg/m^3	< 23.92/m^3 (> 10%)	Large	< 58.72 µg/m^3	Well Below Objective	Slight Adverse
Maximum Roadside Impact	82µg/m^3	< 8.7 µg/m^3 (1-5%)	Small	< 90.7 µg/m^3	Well Below Objective	Negligible
Maximum Impact on Building S2 Facade	34.8 µg/m^3	< 20.00 µg/m^3 (5- 10%)	Medium	< 54.8 µg/m^3	Well Below Objective	Negligible

Hourly concentration assumed = 2 x annual mean background concentration for assessment of short term impacts

Table 8: Summary of assessment of significance of impacts for nitrogen dioxide for the 1100 dwelling phase

5.2 SUMMARY

5.2.1 Air quality in the vicinity of the proposed energy centre at the Bicester Eco Development site is very good, with air quality gradually diminishing with close proximity to major roads.

5.2.2 Air quality is expected to improve in the future, but exceedances of the air quality objectives for annual mean nitrogen dioxide are expected to remain at some roadside locations. Cherwell District council are currently monitoring Queens Avenue and will advise on whether the declaration of an Air Quality Management Area (AQMA) for exceedances of the air quality objective for annual mean nitrogen dioxide is necessary.

5.2.3 With the operation of the energy centre, pollutant concentrations increase in the vicinity of the facility, but the significance of the impact at ground level is generally negligible, increasing to slight adverse for some hourly means at the point of maximum impact.

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It is interesting to note that for hourly mean concentrations (1100 dwellings) although the process emission contribution has increased from 17.84µg/m^3 to 23.92/m^3 (an increase of 6.08 µg/m^3) at the point of maximum ground level impact for hourly mean pollutant concentrations. The monitoring station located at Tamarisk Gardens has recorded a drop in annual mean nitrogen dioxide background concentrations, which equates to a 4.9µg/m^3 drop in hourly mean pollutant concentrations. Reducing the total nitrogen dioxide hourly mean pollutant concentration by 3.72 µg /m^3. The process emission contribution has increased when expressed as a ratio of the hourly mean pollutant objective; as a result the significance has changed from negligible to slight adverse although the total pollution concentration has decreased.

5.2.4 On the upper floors for the 393 dwellings phase the nearby commercial blocks in the vicinity of the energy centre, the impact of the Energy Centre emissions on annual pollutant concentrations is negligible and for hourly pollutant concentration slight adverse. On the upper floors for the 1100 dwellings phase the nearby commercial blocks and in the vicinity of the energy centre, the impact of the Energy Centre emissions is negligible for both annual mean and hourly pollutant concentrations. However, no exceedances of air quality objectives are predicted to result from the emissions.

5.2.5 The results show, for the 393 dwellings phase a 12m flue height would suffice. However, upon completion of the 1100 dwellings (circa 2020) a flue height of 17m will be required.

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APPENDIX A – DISPERSION MODEL INPUT PARAMETERS

Model	ADMS V5.1
Meteorology	Hourly sequential data from Benson , Oxford recording station from 2007 to 2011
Surface Parameters	Surface roughness of 0.2 Agricultural Areas (min), ADMS defaults for Agricultural Areas (min)
Receptors	1 x Cartesian grids
Fine Grid	5m resolution, extending 1.00km from stack at ground level

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Discrete receptors at building façades facing energy centre of:

Location	Receptor name	X	Y
S1 Pharmacy	S1A	457922	224816
	S1B	457932	224821
S2 Office	S2	457933	224830
	S2A	457946	224802
	S2B	457951	224792
S3 Eco Pub	S3	457906	224845
	S3A	457907	224845
	S3B	457908	224845
S4 Apartments	S4	457972	224774
	S4A	457973	224775
	S4B	457974	224775
S5 Shared Ownership Apartments	S5	457991	224782
	S5A	457991	224783
	S5B	457991	224784
S6 Houses	S6	457960	224769
	S6A	457960	224770
	S6B	457960	224771
S7 Eco Business Unit	S7	457989	224793
	S7A	457990	224793
	S7B	457991	224793
S8 Houses	S8	458017	224795
	S8A	458017	224794
	S8B	458017	224793
Remote Receptors	Queens Avenue	458028	222471
	Tarmarisk Gardens	458404	224332
	Market Square	458028	222340
	Defra Background	458500	225500
	B4100	458124	224715
	A4421	459527	225439
Eco Business Unit	S9	457999	224825
S10 Nursery	S10 0m a	457957	224860
	S10 6m a	457957	224860
	S10 9m a	457957	224860
	S10 0m b	457962	224849
	S10 6m b	457962	224849
	S10 9b	457962	224849

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Terrain Not Applicable

Building Downwash Included with the following buildings explicitly considered:

Energy centre housing
S1- Pharmacy Store
S2- Office
S3-Eco Pub
S4-Apartments
S5- Shared Ownership Apartments
S6-Houses (357,358,359)
S7-Eco Business Centre, Core Office, Nursery
S8-Houses (340,341,342)

The main building was set to S2, as this is the tallest building and next to the energy centre

Name	Easting	Northing	Height	Length	Width	Angle
Energy Centre	457946	224778	7.5m	25m	15m	65
S1 Pharmacy	457924	224808	13.6m	40m	16m	65
S2 Rental Unit	457946	224819	13.6	83	12.6	155
S3 Eco Public House	457917	224845	13.6m	16m	10m	65
S4 Apartments	457972	224762	9m	14m	20m	65
S5 Shared Ownership Apartments	458002	224777	9.8m	14m	20m	65
S6 Houses	457954	224760	8.6m	18.1m	8.1m	65
S7 Eco Business Centre Core	458008	224809	13.6m	23.5m	10m	65
S8 Dwellings	458027	224795	8.6m	18.1m	8.1m	65
S7 Eco Business Unit 1	458008	224809	13.6m	23.5m	10m	65
S7 Eco Business Unit 1	457994	224840	13.6m	23.5m	10m	65

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Figure 1: Buildings included in the model for downwash effect

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Model Scenarios 393 Dwellings Phase Most likely annual mean operating scenario (1 x CHP + 1 x Condensing boiler(2 modules combined))

Individual CHP/Boiler Emissions

Parameter	Units	CHP 889kWe	Condensing Boiler (2 Modules) 1.7MW
Exhaust Temperature	C	50	69
Exhaust Gas volumetric Flow	m^3 /hr	4772 @50°C	2580 @ 69°C
Exhaust Gas Mass Flow	kg/h	4732	2662
NO_x Concentration	mg/Nm^3	500mg/Nm3 @ 5% O2	37mg/kWh (x2)
Flue Diameter	m	0.35	0.5
NO_x Emission Rate (full load)	g/s	0.52	0.016
Hours of Operation	Hr/yr	*	*

* See CHP/Boiler Time Varying profile in Appendix B

Pollutants Nitrogen oxides only. Carbon monoxide and PM10 was scoped out of the assessment as having a negligible impact and no significant background concentrations. Emissions were calculated from data for indicative boilers & CHP (Hoval Ultragas 850, Hoval Max 3 1500, & CHP JMS 412 GS-N.L).

Outputs Annual mean.
99.79^{th} percentile of hourly concentrations for NO_x (equivalent to 18^{th} highest hourly average concentration).
98.1^{st} percentile of daily mean concentrations for PM_{10} (equivalent to 7^{th} highest daily average concentration).

NO_x to NO_2 Following EA guidance for worse case assumption.
70% of NO_x = NO_2 for annual mean concentrations.
35% of NO_x = NO_2 for hourly mean concentrations.

Background Concentrations Assumed constant in time from 2013 monitored concentrations.

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Model Scenarios 1100 Dwellings Phase Most likely annual mean operating scenario (1 x CHP + 2 x Condensing boiler(2 modules combined)+ HE Boiler)

Individual CHP/Boiler Emissions

Parameter	Units	CHP 889kWe	Condensing Boiler (2 Ultragas Modules) 1.7MW	He Boiler (Max3)
Exhaust Temperature	C	50	69	180
Exhaust Gas volumetric Flow	m^3 /hr	4772 @50°C	2580 @ 69°C	3890@180°C
Exhaust Gas Mass Flow	kg/h	4732	2662	3031
NO_x Concentration	mg/Nm^3	500mg/Nm3 @ 5% O2	87 (equivalent to 110mg/kWh)	63 mg/kWh
Flue Diameter	m	0.35	0.85	0.45
NO_x Emission Rate (full load)	g/s	0.52	0.016	0.034

* See CHP/Boiler Time Varying profile in Appendix B

Pollutants Nitrogen oxides only. Carbon monoxide and PM10 was scoped out of the assessment as having a negligible impact and no significant background concentrations. Emissions were calculated from data for indicative boilers & CHP (Hoval Ultragas 850, Hoval Max 3 1500, & CHP JMS 412 GS-N.L).

Outputs Annual mean.
99.79th percentile of hourly concentrations for NO_x (equivalent to 18th highest hourly average concentration).
98.1st percentile of daily mean concentrations for PM_{10} (equivalent to 7th highest daily average concentration).

NO_x to NO_2 Following EA guidance for worse case assumption.
70% of NO_x = NO_2 for annual mean concentrations.
35% of NO_x = NO_2 for hourly mean concentrations.

Background Concentrations Assumed constant in time from 2013 monitored concentrations.

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APPENDIX B – FIGURES

Figure 1: Study area showing buildings included in the dispersion modelling for the Bicester Energy Centre and discrete receptors identified as solid red circles. The Energy Centre stack is shown in green.

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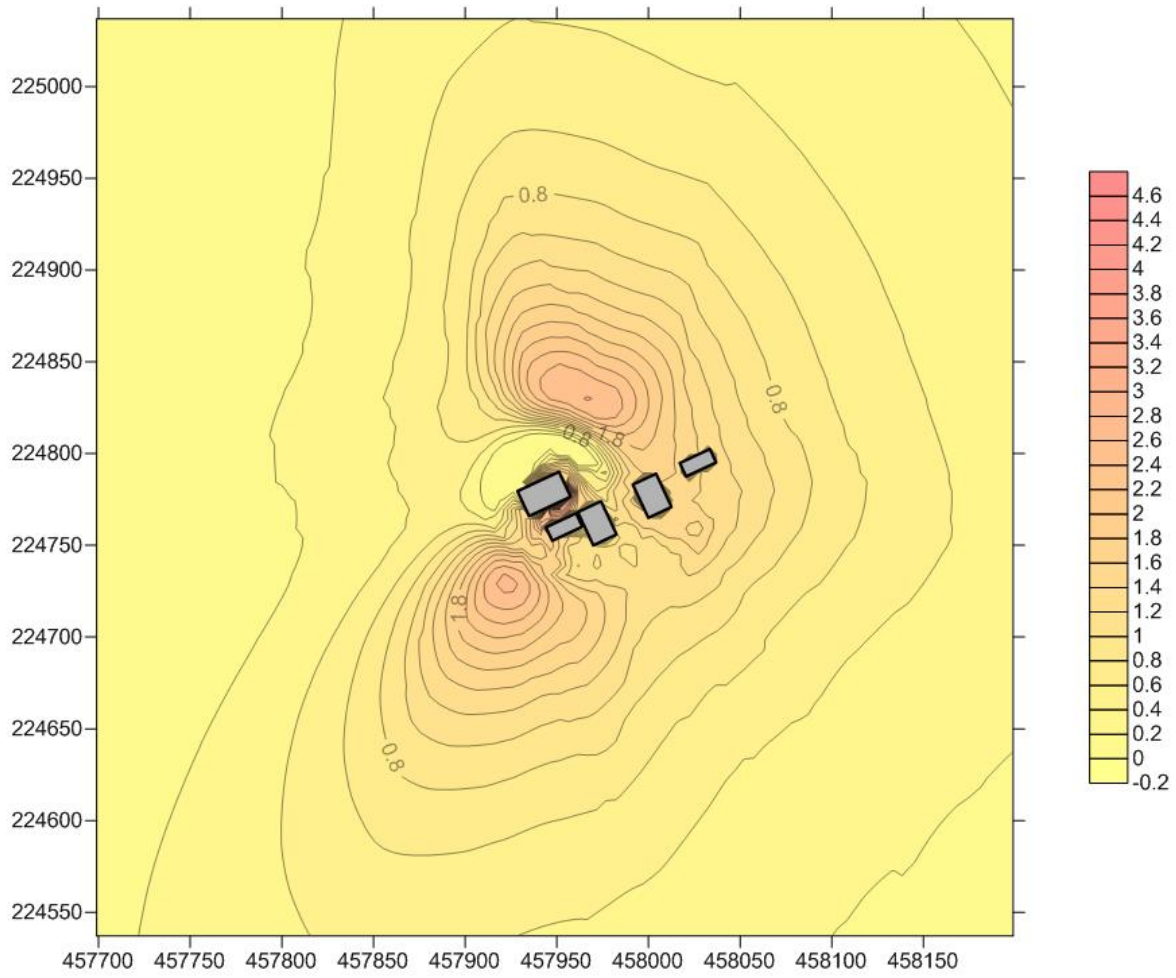

Figure 2: Annual average ground level nitrogen dioxide concentrations (µg/m^3) for 393 Dwellings phase, modelled using meteorological data from 2010. Contours are drawn at 0.2µg/m^3 intervals.

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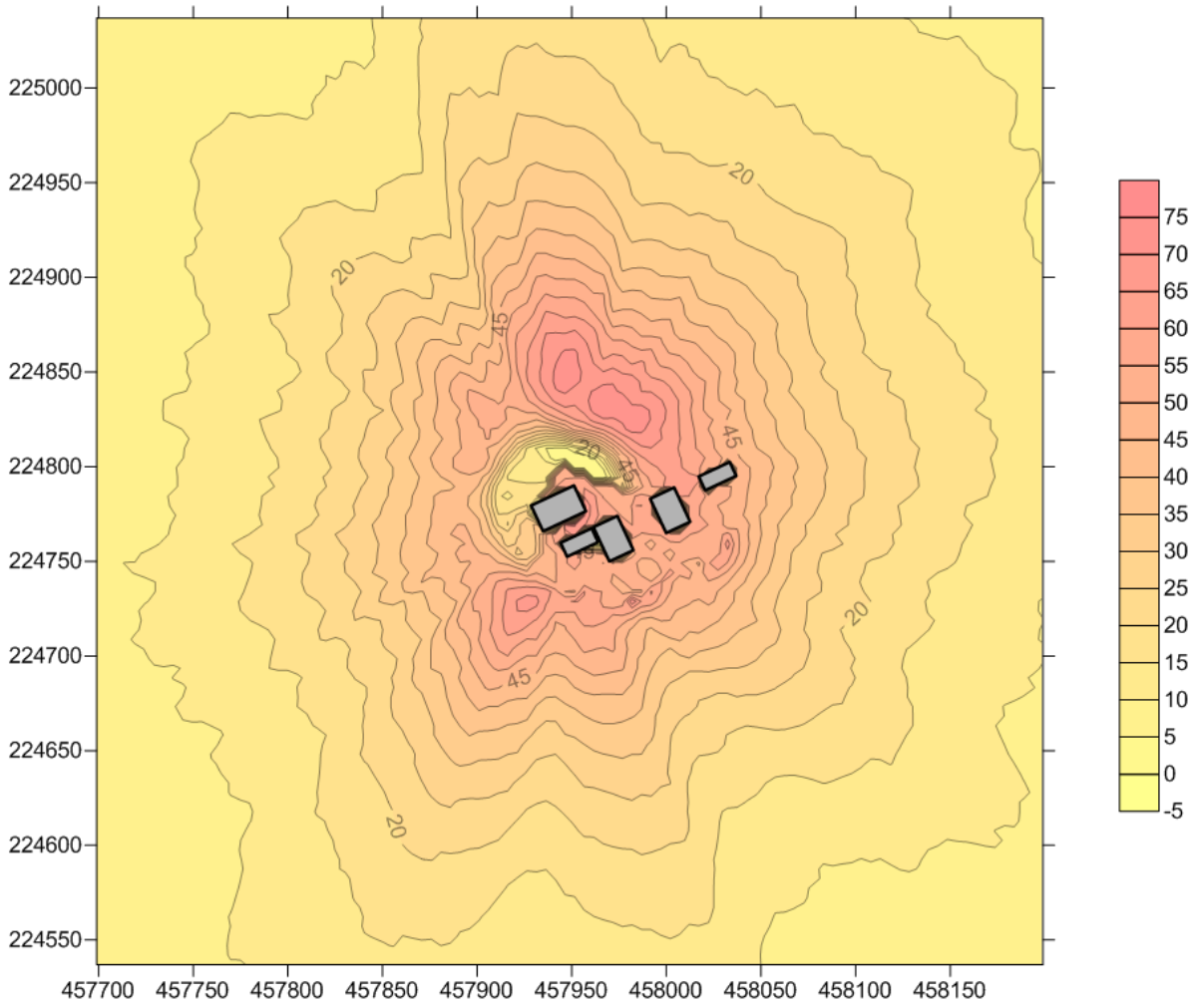

Figure 3: Hourly average ground level nitrogen dioxide concentrations (µg/m^3) for 393 Dwellings phase, modelled using meteorological data from 2008. Contours are drawn at 0.5µg/m^3 intervals.

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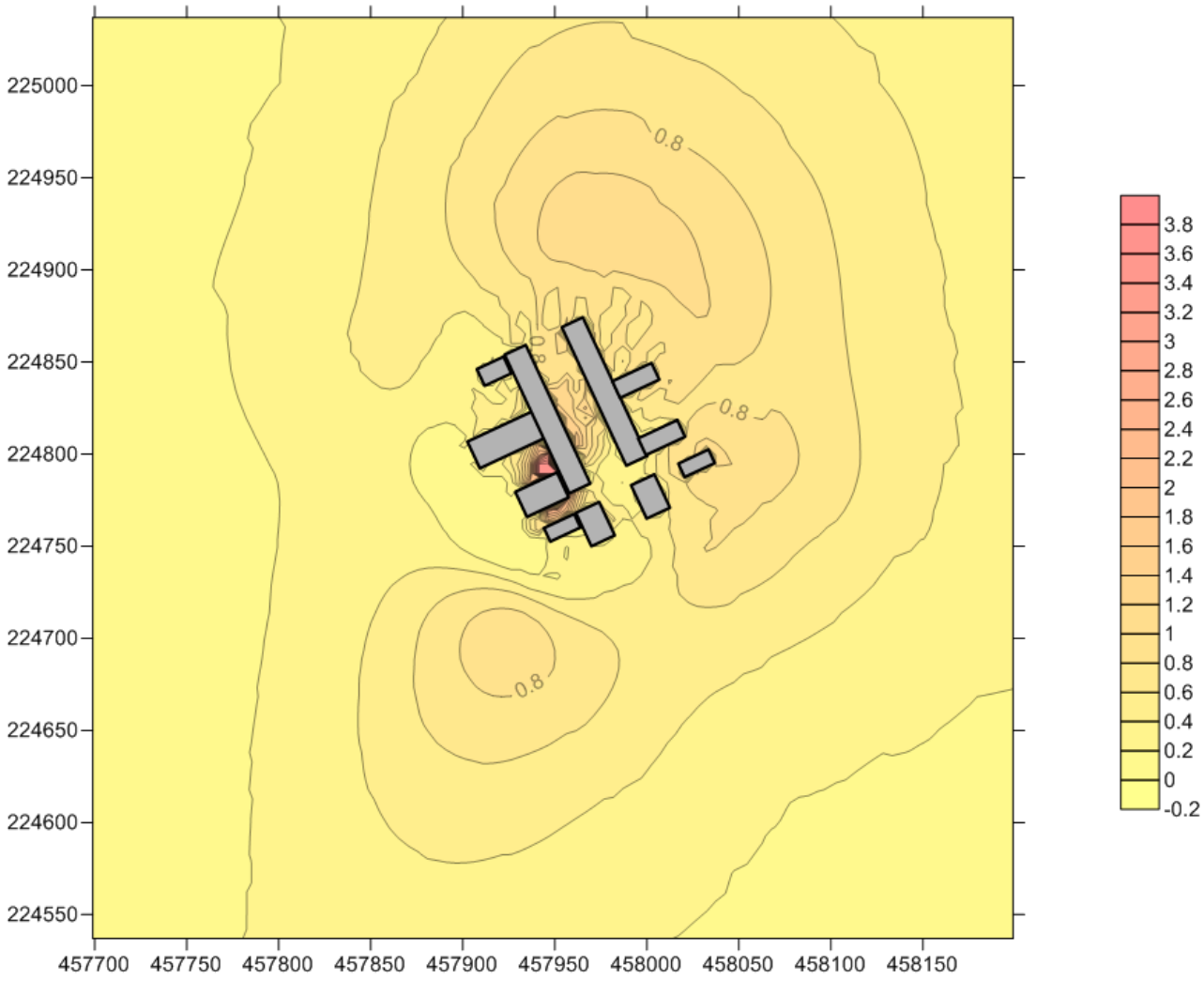

Figure 4: Annual average ground level nitrogen dioxide concentrations (µg/m^3) for 1100 Dwellings phase, modelled using meteorological data from 2010. Contours are drawn at 0.2µg/m^3 intervals.

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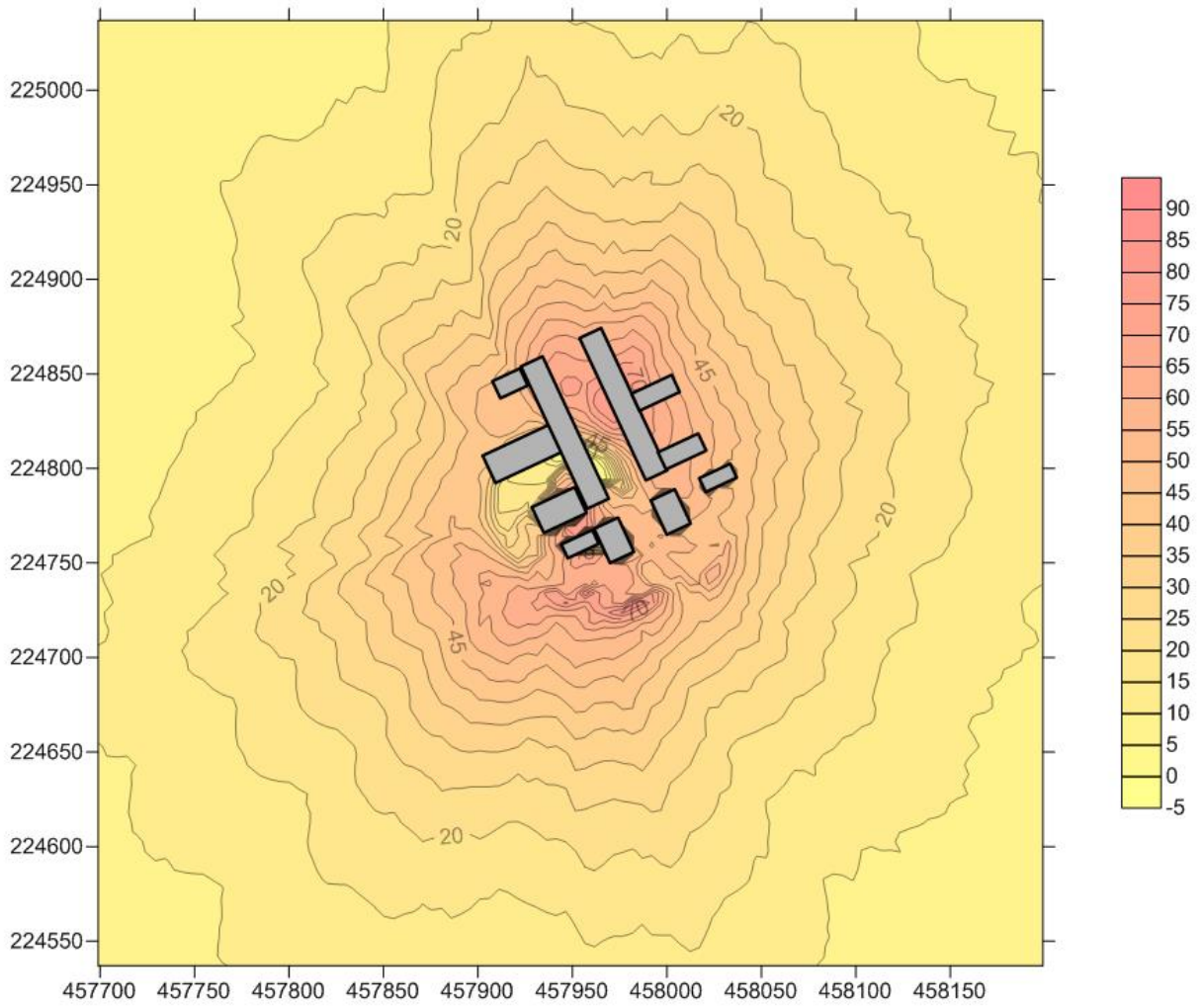

Figure 5: Hourly average ground level nitrogen dioxide concentrations (µg/m^3) for 1100 Dwellings phase, modelled using meteorological data from 2008. Contours are drawn at 5µg/m^3 intervals.

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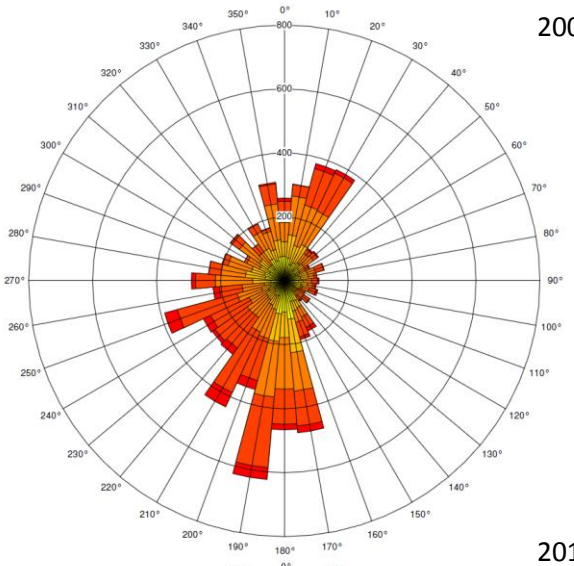
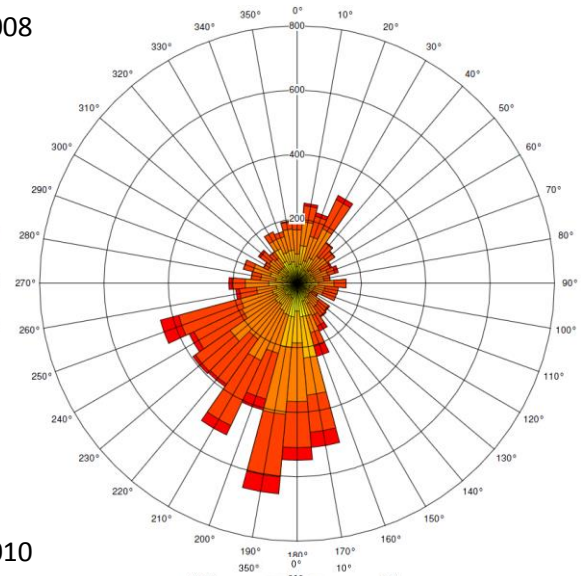
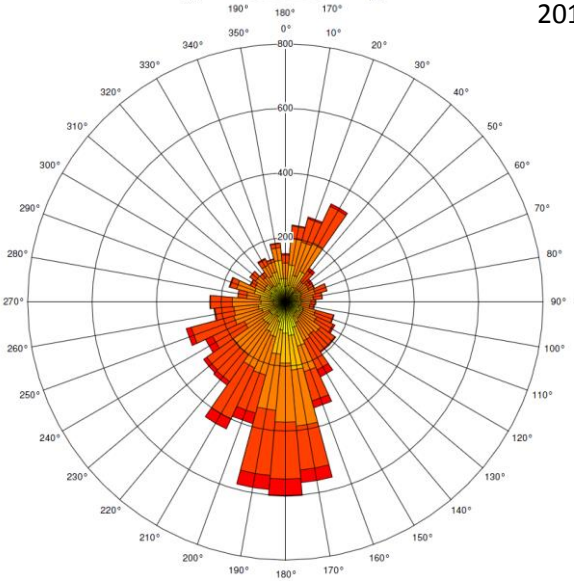
2007



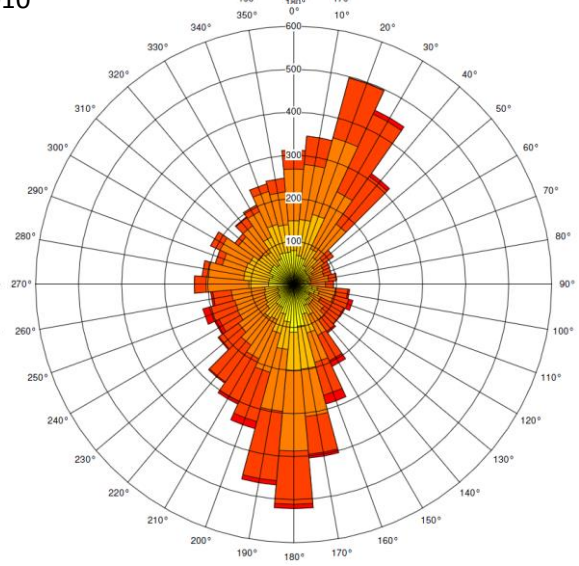
2008

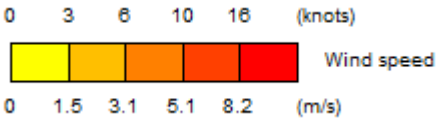


2009



2010





Wind roses continue on the following page

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2011

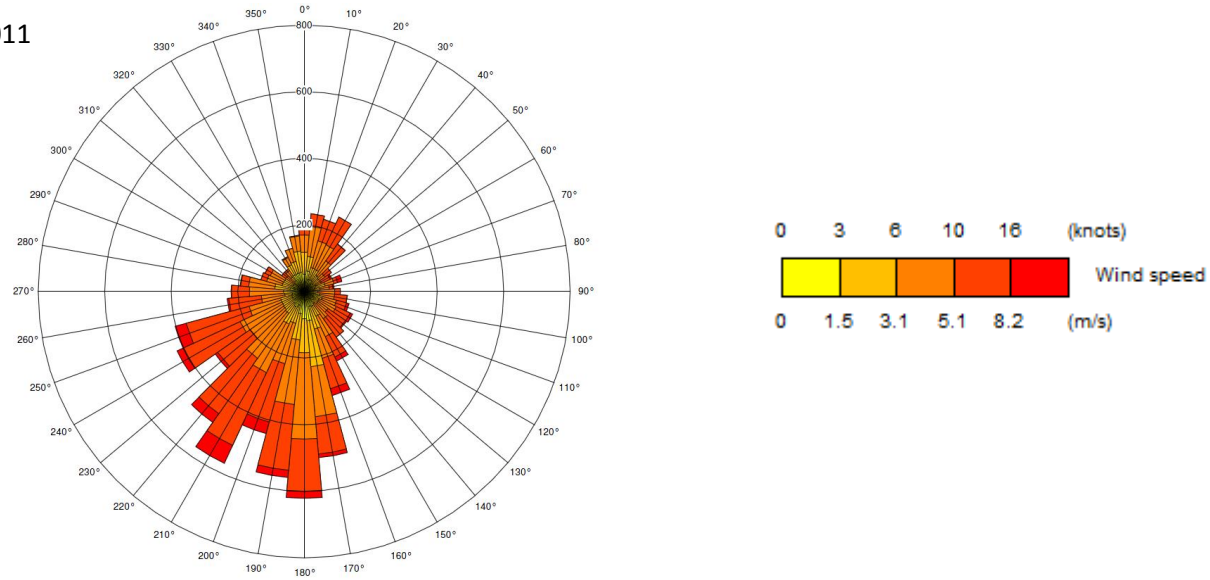

Figure 6: Wind roses for Benson Met Station 2007 to 2011

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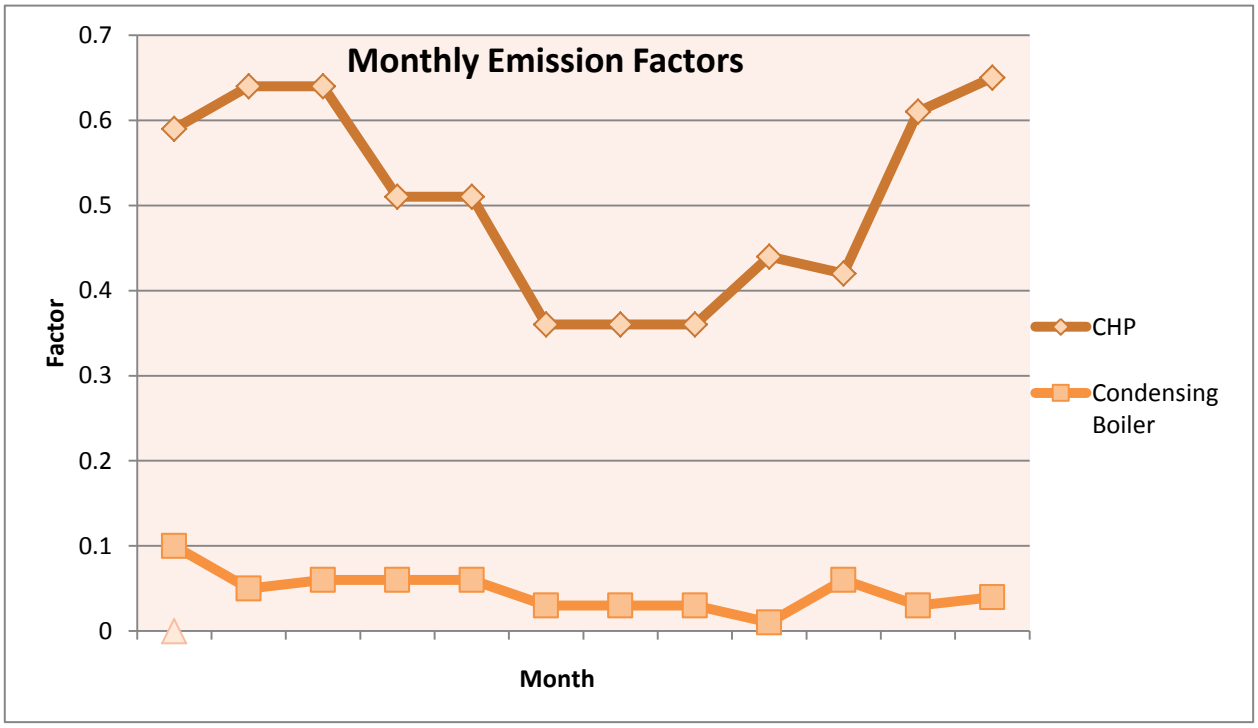

Figure 7: Monthly emissions factors for 393 dwelling phase

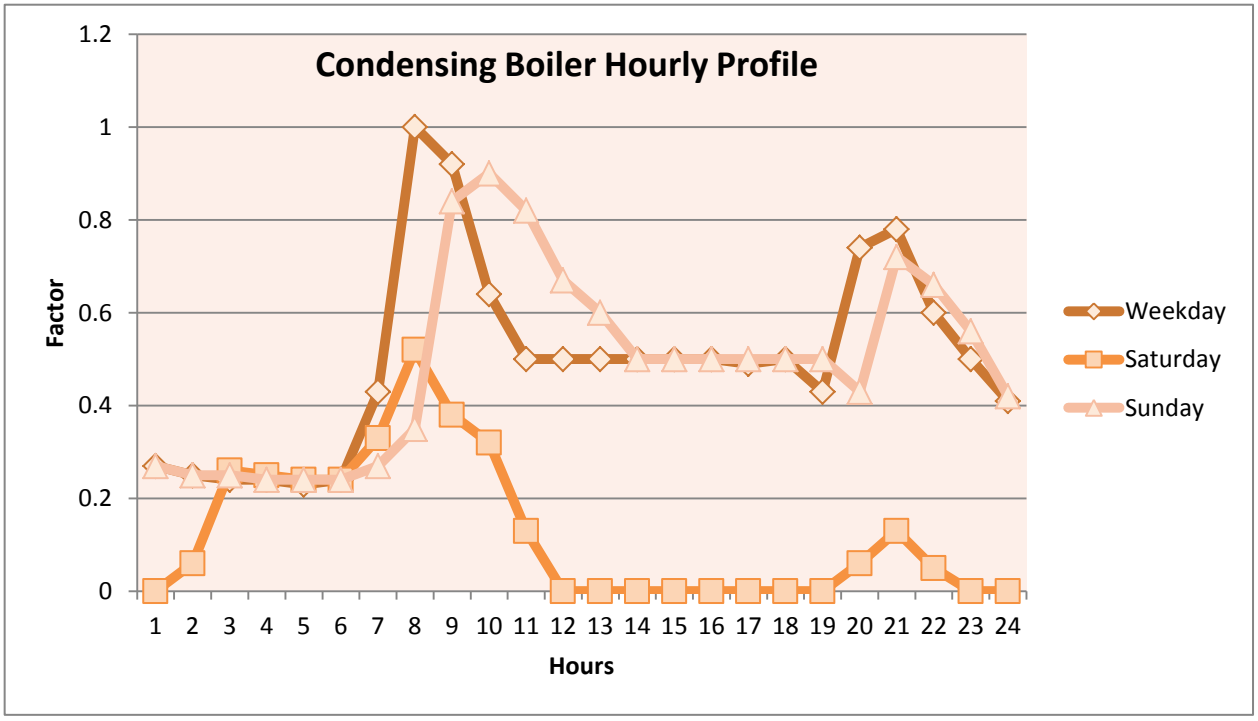

Figure 8: Condensing boiler hourly profile for 393 dwelling phase

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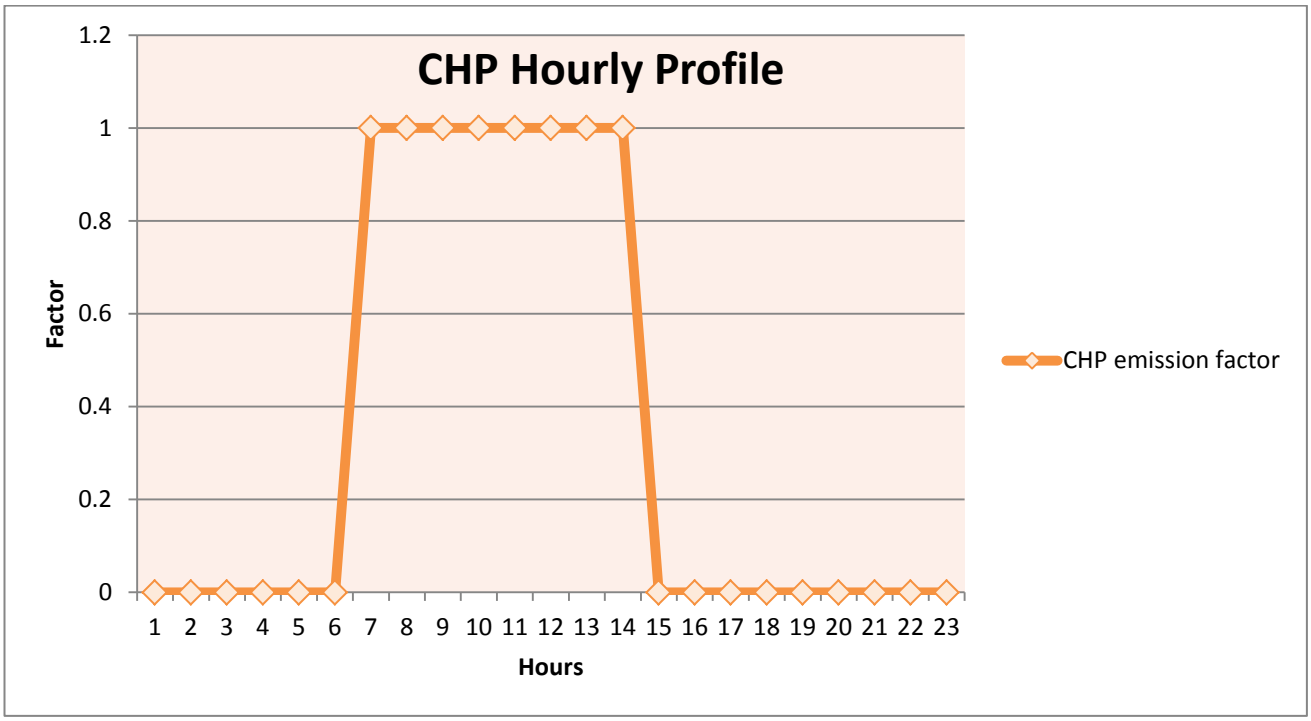

Figure 9: Monthly emissions factors for 393 dwelling phase

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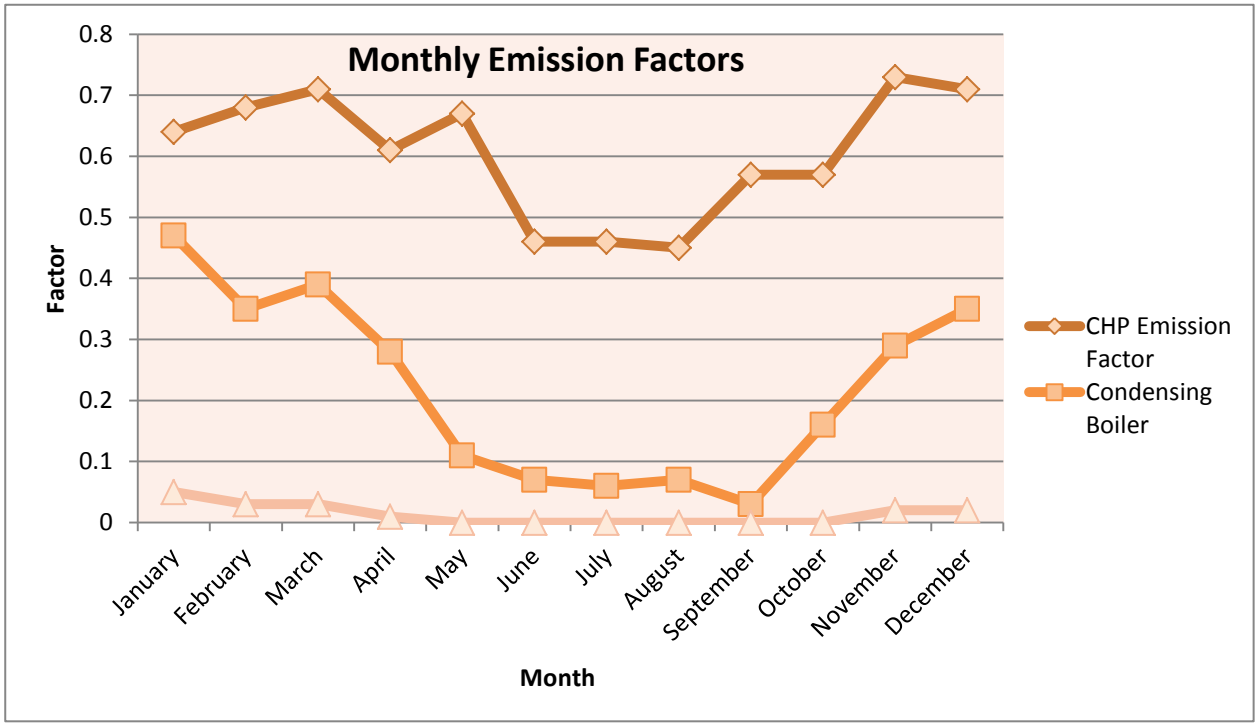

Figure 10: Monthly emissions factors for1100 dwelling phase

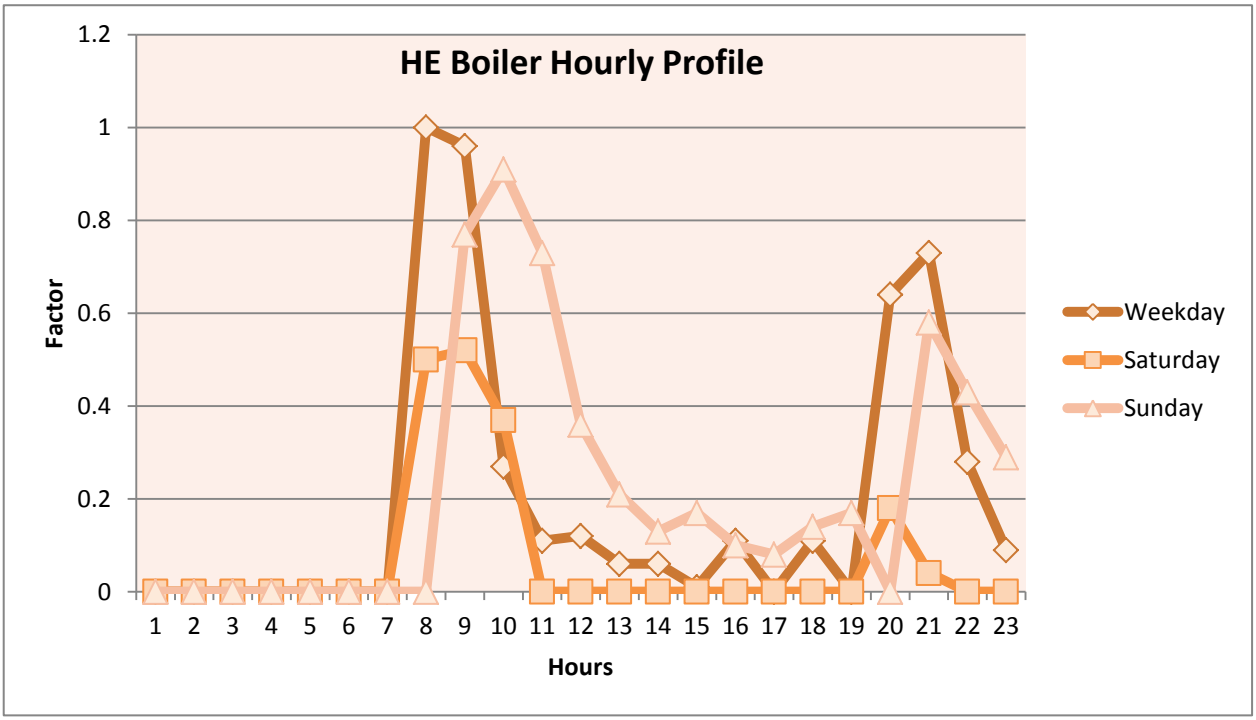

Figure 11: Hourly emissions factors for HE boiler, 1100 dwelling phase

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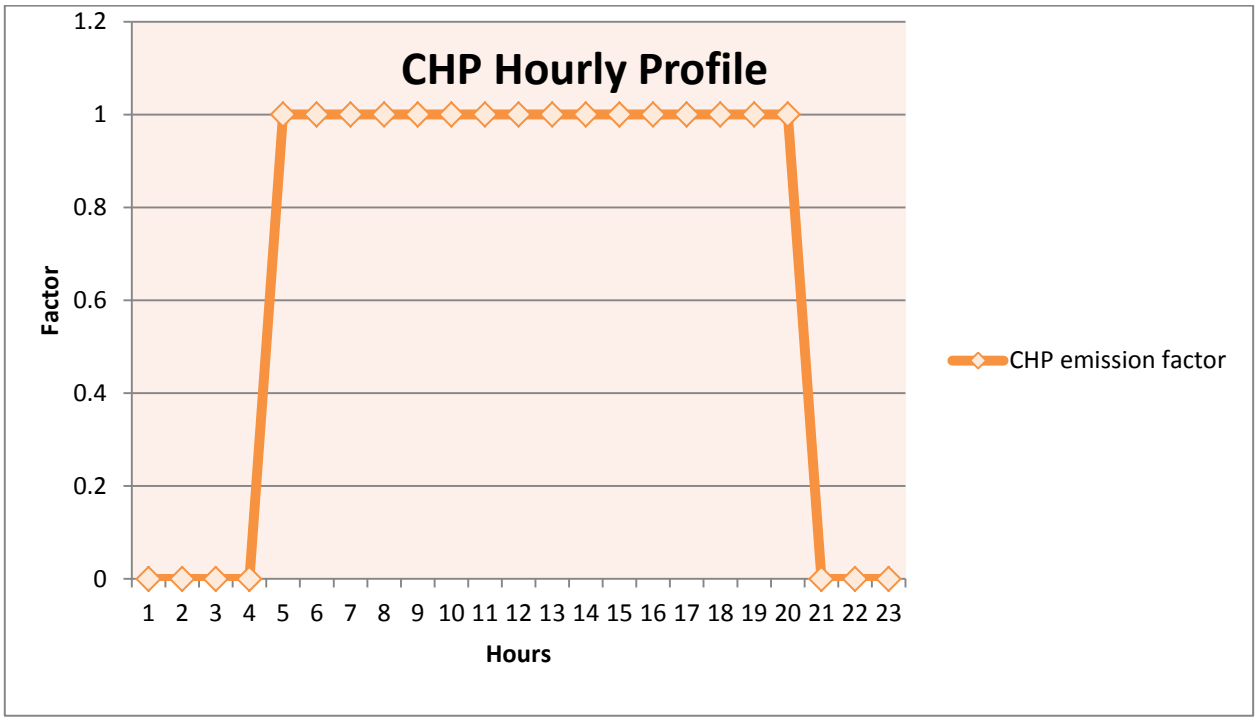

Figure 12: Hourly emissions factors for CHP boiler, 1100 dwelling phase

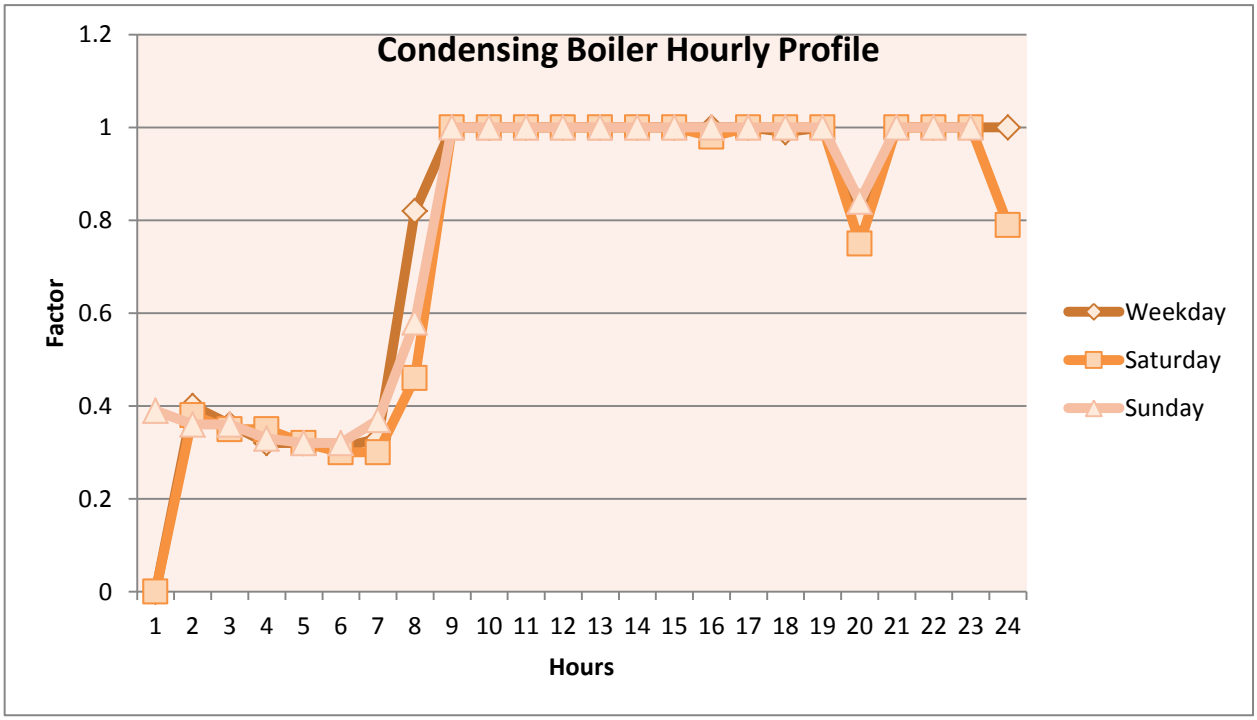

Figure 13: Hourly emissions factors for condensing boiler, 1100 dwelling phase

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