Table 2
Emissions of sulphur oxides obtained from the application of technological options to fossil-fuelled boilers

Uncontrolled emissions		Additive injection		Wet scrubbing <u>a</u> /		Spray dry absorption b/	
		up to 60		95		up to 90	
		0.1 - 1		6 - 10		3 - 6	
				194,000		16,000	
		Mix of Ca salts and fly ashes 20 - 50		Gypsum (sludge/ waste water) 60 - 250		Mix of CaSo ₃ * 1/2 H ₂ O and fly ashes 50 - 220	
1,000-10,000	3.5-35	400-4,000	1.4-14	<400 (<200, 1% S)	<1.4 <0.7	<400 (<200, 1% \$)	<1.4 <0.7
1,000-20,000	4.2-84	400-8,000	1.7-33.6	<400 (<200, 1% S)	<1.7 <0.8	<400 (<200, 1% \$)	<1.7 <0.8
1,000-10,000	2.8-28	400-4,000	1.1-11	<400 (<200, 1% S)	<1.1 <0.6	<400 (<200, 1% S)	<1.1 <0.6
Ammonia scrubbing <u>b</u> /		Wellman Lord a/		Activated carbon a/		Combined catalytic a/	
up to 90		95		95		95	
3-10		10-15		4-8		2	
200		2,000		700		1 300	
						1,300	
Ammonia fertil	izer	Elemental S Sulphuric aci	d (99 vol.%)	Elemental S Sulphuric acid	(99 vol.%)	Sulphuric acid	(70 wt.%)
Ammonia fertil	lizer		d (99 vol.%)		(99 vol.%)		(70 wt.%)
	izer g/kWh _{ei}	Sulphuric aci	d (99 vol.%) ; g/kWh _{el}	Sulphuric acid	(99 vol.%) g/kWh _{el}	Sulphuric acid	(70 wt.%)
230-270 <u>e</u> /	g/kWh _{ei}	Sulphuric aci	g/kWh _{ei}	Sulphuric acid 280-320 <u>e</u> / <u>f</u> /		Sulphuric acid 320-350 <u>e</u> / <u>f</u> /	g/kWh _{e!}
230-270 <u>e</u> / mg/m ³ <u>c</u> / <400	g/kWh _{ei} <1.4 <0.7 <1.7	Sulphuric aci 200-300 <u>e</u> / mg/m ³ <u>c</u> / <400	g/kWh _{el} <1.4 <1.4 S) <0.7	Sulphuric acid 280-320 <u>e</u> / <u>f</u> / mg/m ³ <u>c</u> / <400	g/kWh _{el}	Sulphuric acid 320-350 <u>e</u> / <u>f</u> / mg/m ³ <u>c</u> / <400	g/kWh _{el} <1.4 <0.7 <1.7
	mg/m ³ <u>c</u> / 1,000-10,000 1,000-20,000 1,000-10,000 Ammonia scru up to 90 3-10	mg/m ³ <u>c</u> / g/kWh _{el} 1,000-10,000 3.5-35 1,000-20,000 4.2-84 1,000-10,000 2.8-28 Ammonia scrubbing <u>b</u> / up to 90 3-10	up to 60 0.1 - 1 Mix of Ca sal ashes 20 - 50 mg/m³ c/ g/kWhel mg/m³ c/ 1,000-10,000 3.5-35 400-4,000 1,000-20,000 4.2-84 400-8,000 1,000-10,000 2.8-28 400-4,000 Ammonia scrubbing b/ Wellman Lord up to 90 95 3-10 10-15	up to 60 0.1 - 1 Mix of Ca salts and fly ashes 20 - 50 mg/m³ c/ g/kWhel mg/m³ c/ g/kWhel 1,000-10,000 3.5-35 400-4,000 1.4-14 1,000-20,000 4.2-84 400-8,000 1.7-33.6 1,000-10,000 2.8-28 400-4,000 1.1-11 Ammonia scrubbing b/ Wellman Lord a/ up to 90 95 3-10 10-15	up to 60 95 0.1 - 1 6 - 10 194,000 Mix of Ca salts and fly ashes water) 20 - 50 60 - 250 mg/m³ c/ g/kWhel mg/m³ c/ g/kWhel mg/m³ c/ 1,000-10,000 3.5-35 400-4,000 1.4-14 < 400 (< 200, 1% S) 1,000-20,000 4.2-84 400-8,000 1.7-33.6 < 400 (< 200, 1% S) 1,000-10,000 2.8-28 400-4,000 1.1-11 < 400 (< 200, 1% S) Ammonia scrubbing b/ Wellman Lord a/ Activated carbiup to 90 95 95 3-10 10-15 4-8	up to 60 0.1 - 1 6 - 10 194,000 Mix of Ca salts and fly ashes 20 - 50 60 - 250 mg/m³ c/ g/kWh _{el} mg/m³ c/ g/kWh _{el} mg/m³ c/ g/kWh _{el} 1,000-10,000 3.5-35 400-4,000 1.4-14 < 400 < 1.4 (< 200, 1% S) < 0.7 1,000-20,000 4.2-84 400-8,000 1.7-33.6 < 400 < 1.7 (< 200, 1% S) < 0.8 1,000-10,000 2.8-28 400-4,000 1.1-11 < 400 < 1.1 (< 200, 1% S) < 0.8 1,000-10,000 2.8-28 400-4,000 1.1-11 < 400 < 1.1 (< 200, 1% S) < 0.6 Ammonia scrubbing b/ Wellman Lord a/ Activated carbon a/ up to 90 95 3-10 10-15 4-8	up to 60 0.1 - 1 6 - 10 3 - 6 194,000 16,000 Mix of Ca salts and fly ashes 20 - 50 60 - 250 50 - 220 mg/m³ c/ g/kWhel mg/m³ c/ g/kWhel mg/m³ c/ g/kWhel mg/m³ c/ 1,000-10,000 3.5-35 400-4,000 1.4-14 400 <1.4 400 <1.7 400 <1.7 400 <200, 1% S) 1,000-20,000 4.2-84 400-8,000 1.7-33.6 400-4,000 1.1-11 400 <1.1 400 <1.1 400 <1.1 400 400-10,000 2.8-28 400-4,000 1.1-11 400 <1.1 400 400-10,000 2.8-28 400-4,000 1.1-11 400 <1.1 400 400-10,000 2.8-28 400-4,000 1.1-11 400 <1.1 400 400-10,000 2.8-28 400-10,000 4.2-84 400-10,000 1.1-11 400 <1.1 400 400-10,000 4.2-84 400-10,000 4.2-84 400-10,000 4.2-84 400-10,000 5.8-28 400

- a/ For high sulphur content in the fuel the removal efficiency has to be adapted. However, the scope for doing so may be process-specific. Availability of these processes is usually 95%.
 - b/ Limited applicability for high-sulphur fuels.
 - c/ Emission in mg/m³ (STP), dry, 6% oxygen for solid fuels, 3% oxygen for liquid fuels.
- \underline{d} / Conversion factor depends on fuel properties, specific fuel gas volume and thermal efficiency of boiler (conversion factors (m³/kWh_{el}, thermal efficiency: 36%) used: hard coal: 3.50; brown coal: 4.20; heavy oil: 2.80).
 - e/ Specific investment cost relates to a small sample of installations.
 - f/ Specific investment cost includes denitrification process.

The table was established mainly for large combustion installations in the public sector. However, the control options are also valid for other sectors with similar exhaust gases.