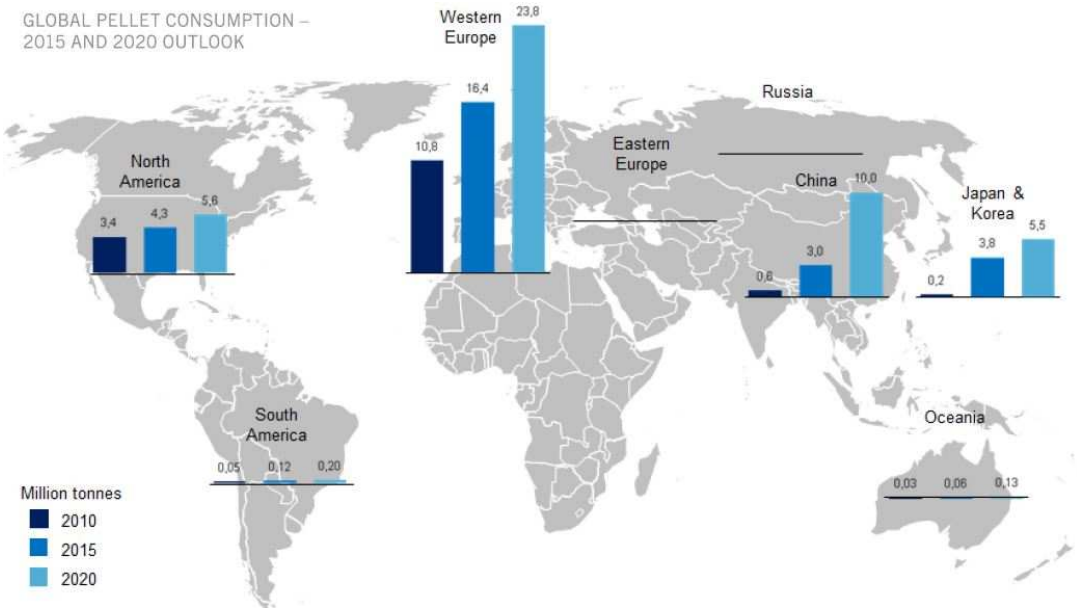

Figure 1: Global pellet consumption and outlook (Pöyry, 2012)

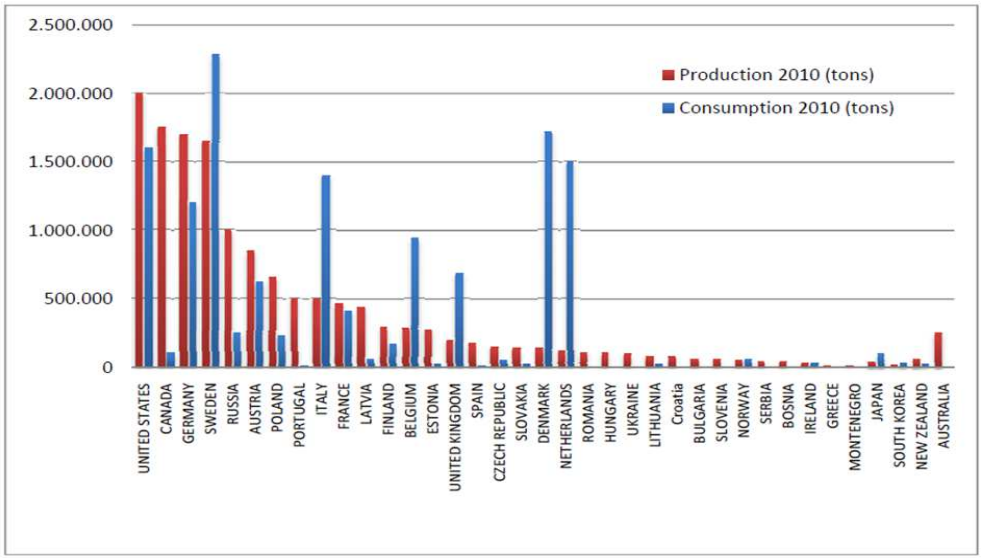

Figure 2: Production and consumption of wood pellets worldwide (Source: IEA 2012)

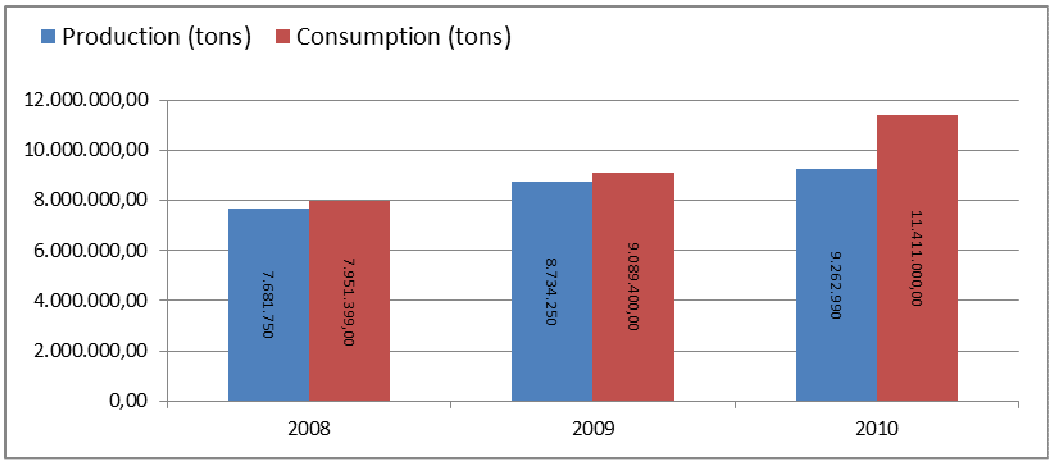

Figure 3: Production and consumption of wood pellets within the European Union (Source: IEA 2012)

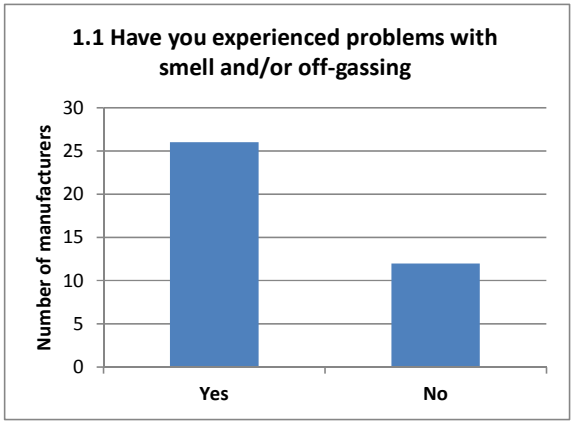

Figure 4: Manufacturers answers related to the overall problem with smell and off-gassing

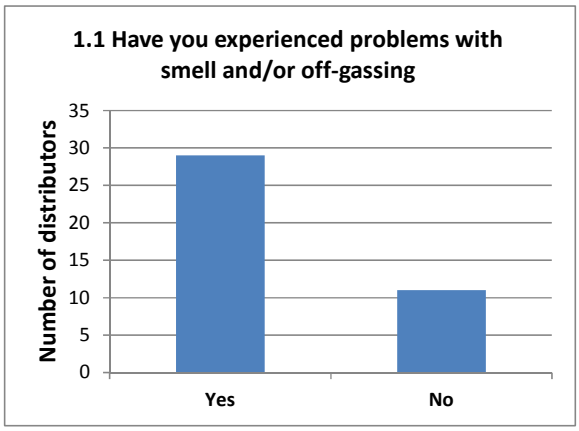

Figure 5: Distributers answers related to the overall problem with smell and off-gassing

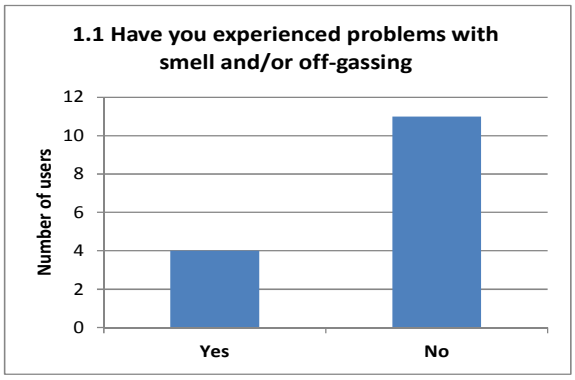

Figure 6: Users answers related to the overall problem with smell and off-gassing

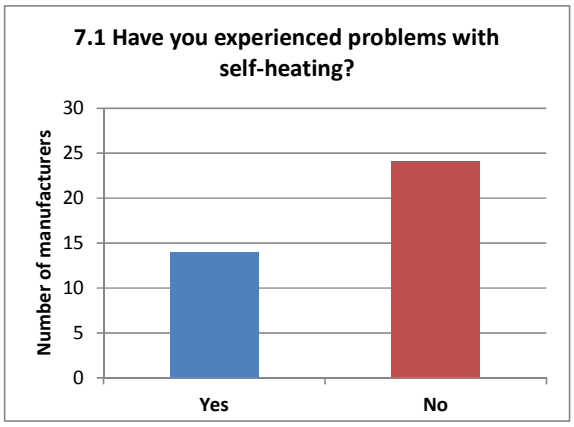

Figure 7: Manufacturers answers related to the overall problem with self-heating

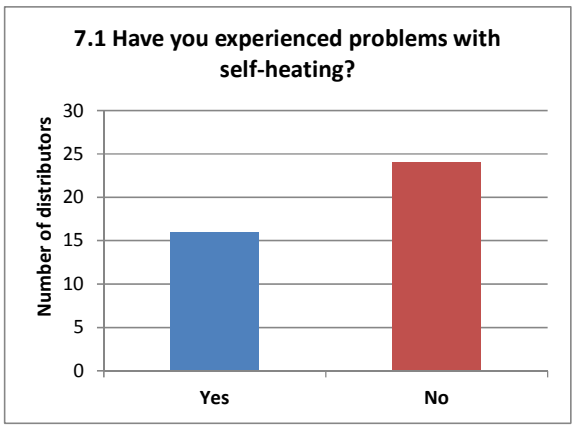

Figure 8: Distributers answers related to the overall problem with self-heating

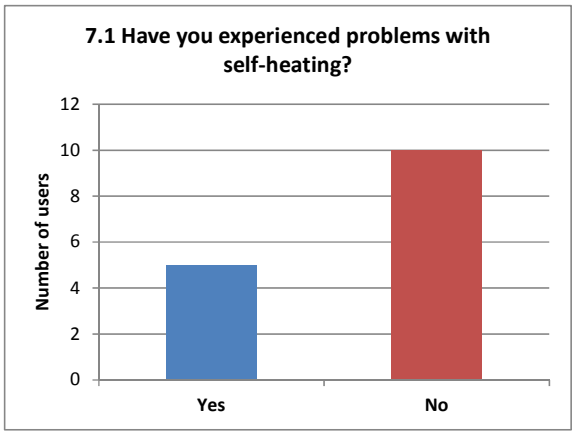

Figure 9: Users answers related to the overall problem with self-heating

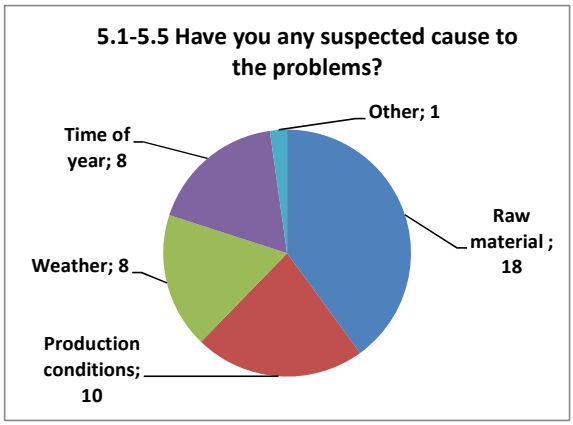

Figure 10: Manufacturers answers to suspected causes for problems with smell and off-gassing

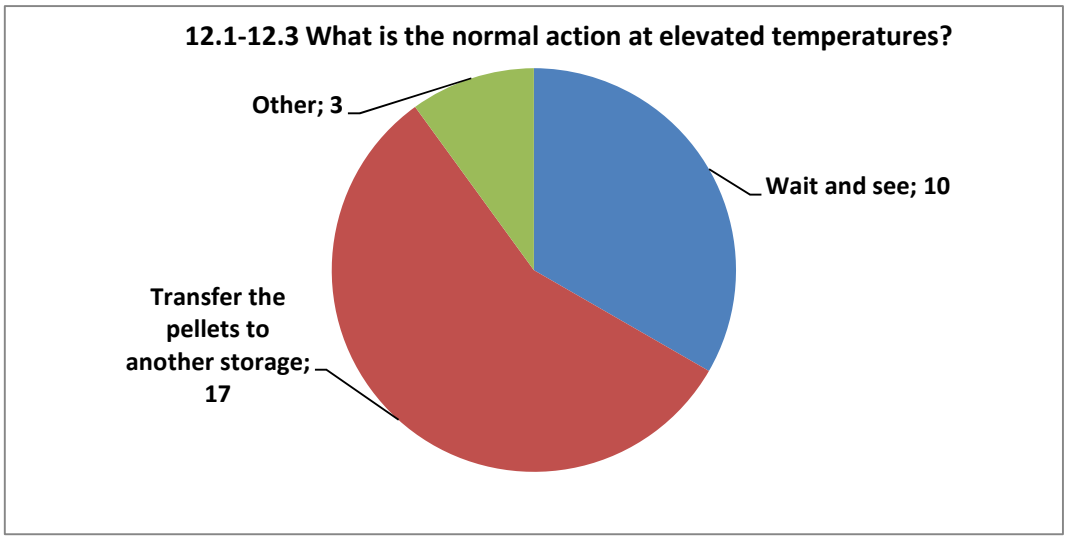

Figure 11: Measures to be taken by manufacturers in case of self-heating incidents

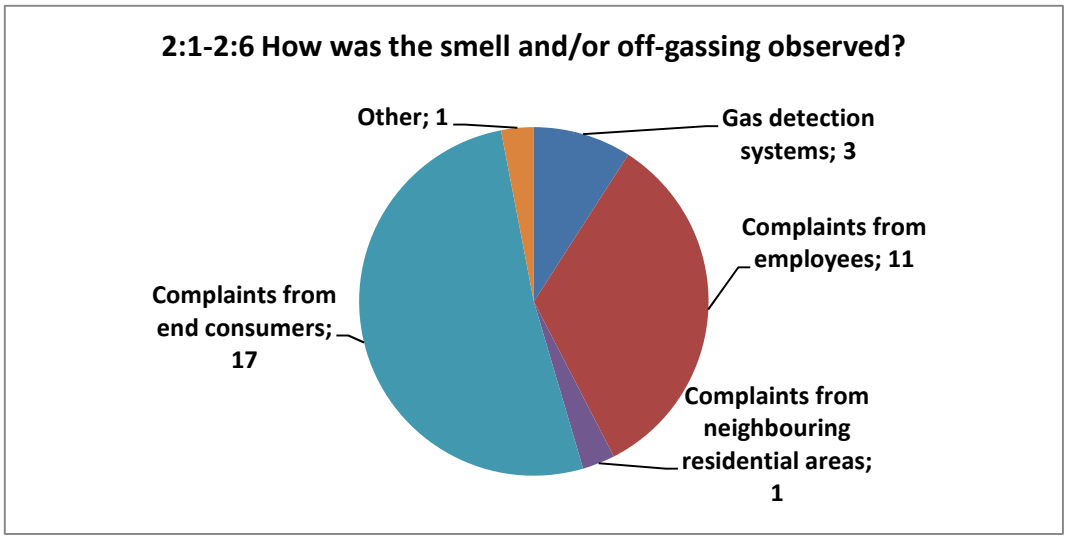

Figure 12: Distributors answers on the detection of smell and/or off-gassing from pellets

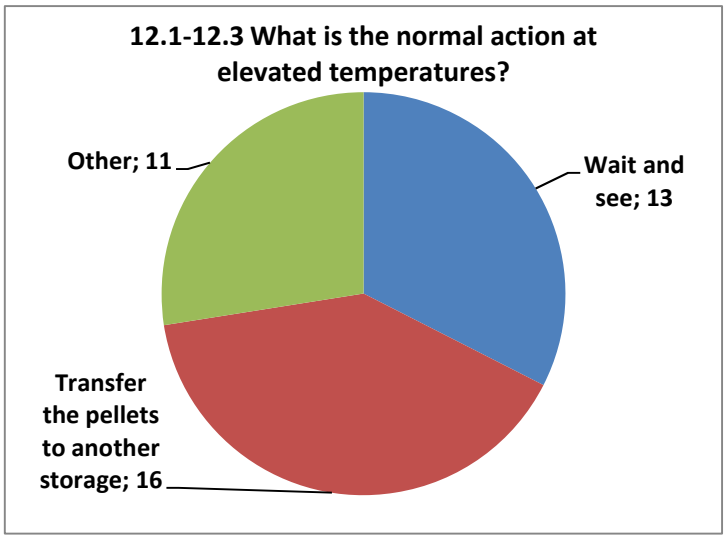

Figure 13: Measures to be taken by distributors in case of self-heating incidents

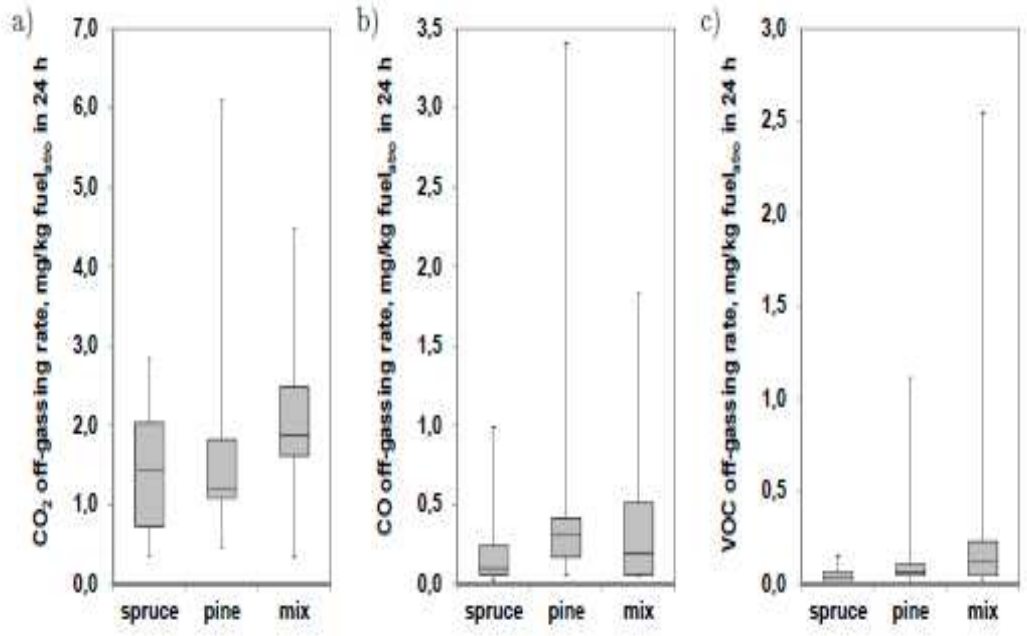

Figure 14: Boxplots for the off-gassing rates of pellets made from spruce, pine and mixtures of both wood species for a) CO2, b) CO and c) VOC emissions

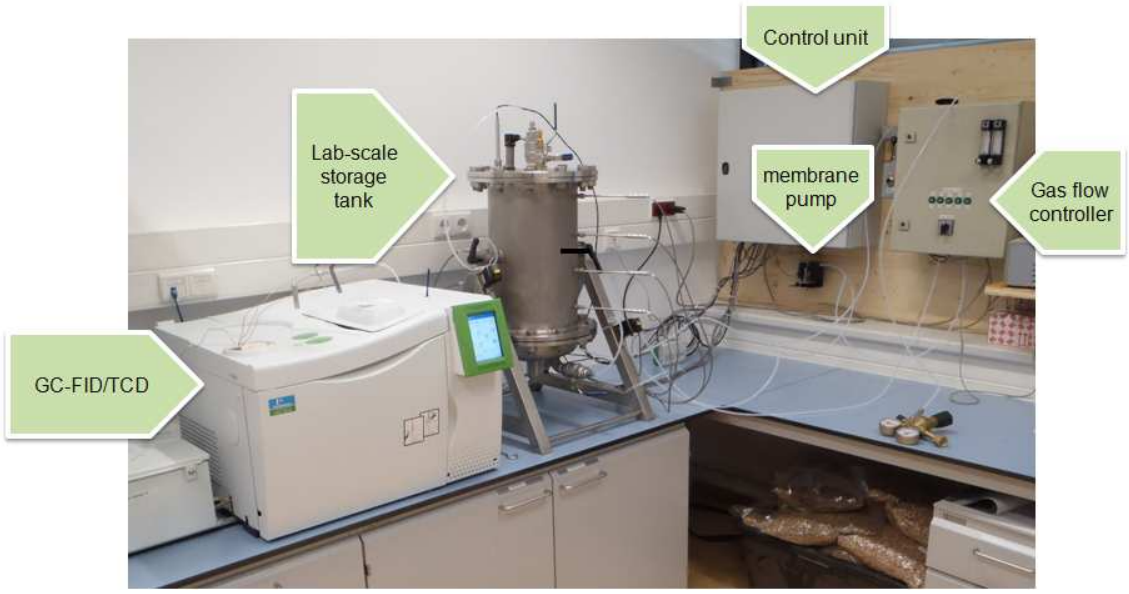

Figure 15: Photograph of the kinetic apparatus

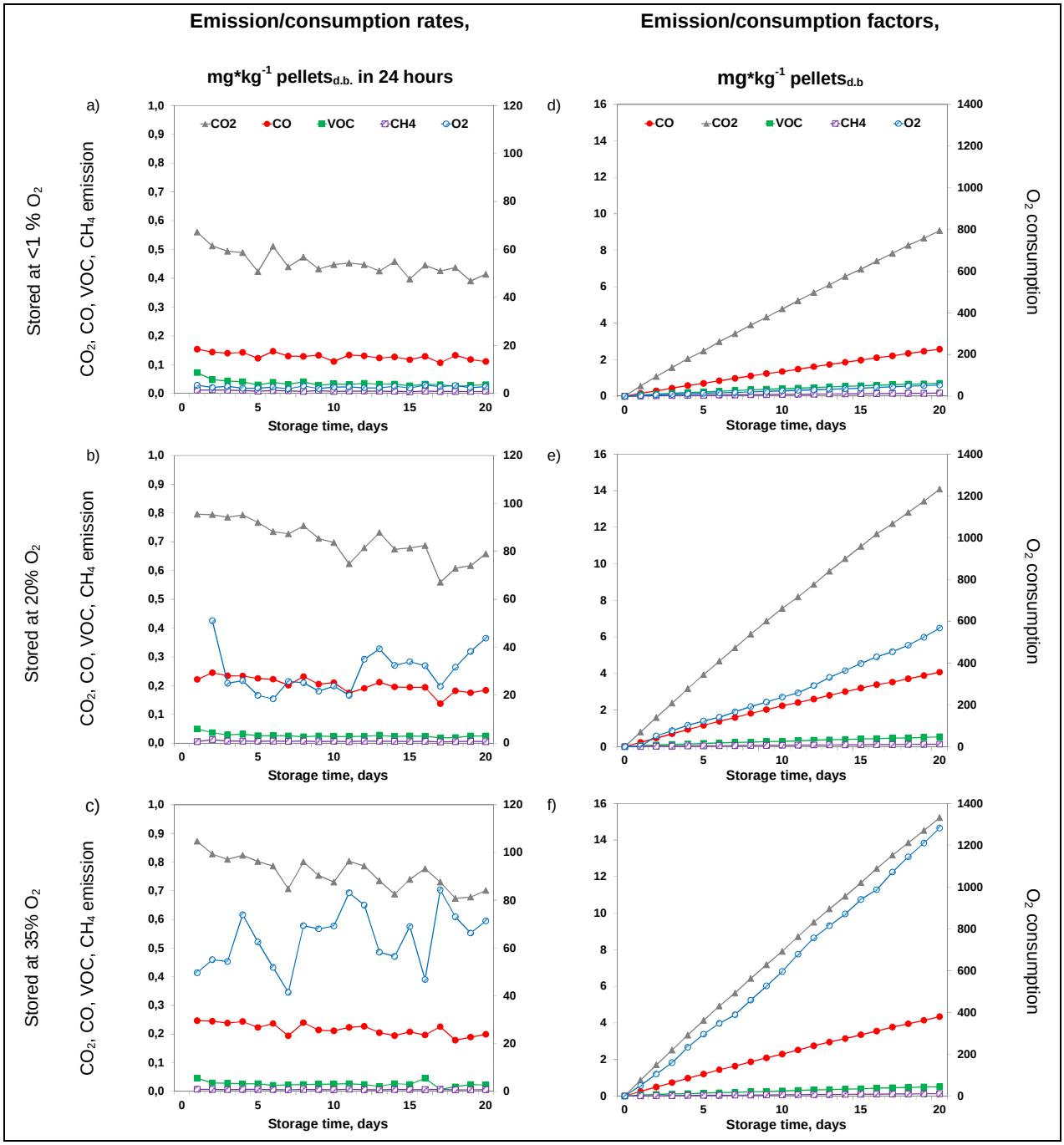

Figure 16: Off-gassing/consumption rates dependent on the oxygen content of the storage atmosphere a) at 0% b) at 20% and c) at 35% O2; Emission/consumption factors d) at 0% e) at 20% and f) at 35% O2. The values of the O2 consumption rates and factors are to be read from the secondary y-axis

Batch no.	BE2020		SP	SLU	
	CO	VOC	Microcalorimetry	CO	Aldehydes
12	1	1	3	1	2
14	2	5	7	2	1
9	3	2	1	3	3
16	4	6	8	7	4
15	5	-	10	6	5
6	6	3	2	4	6
10	7	8	4	5	7
17	8	4	14	13	14
5	9	7	6	10	8
1	10	15	13	16	12
2	11	13	15	14	11
7	12	14	11	11	13
21	13	12	16	-	-
8	14	9	12	12	10
13 – non wood	15	10	9	8	-
22 – non wood	16	17	-	17	-
18 – non wood	17	16	5	9	9
11 – non wood	18	11	17	15	15

Figure 17: Comparison of activity ranking for off-gassing/self-heating potential of pellet samples from different methods

Figure 18: Photo of the 1 m^3 test set-up with the insulated test container

Table 1: Summary of the answers of the questionnaires on incident reports

	Sweden	Denmark	Austria	Germany	Total
Manufacturer	17	5	10	6	38
Distributor	4	8	10	18	40
User	11	4	0	0	15
Total	32	17	20	24	93

Table 2. Overall percentage of respondents along the chain of supply of pellets indicating problems with smell and off-gassing, self-heating and fires

Type of problem	Manufacturers (%)	Distributors (%)	Users (%)
Smell and off-gassing	68	73	27
Self-heating	37	40	33
Fire incidents due to self-heating	10	20	20
Fire incidents, other causes	35	15	35

Table 3: Overview on real-scale storage experiments

Trial	Pellets			Analyses				Duration
	Type	Tons	Age	T	RH	Gasses	VOC	Months
Underground tank								
Long term x 3 (GEO)	Spruce, ENplus	6	Fresh	X	X	CO		1 - 2
Ventilation x 3 (GEO)		< 1		X		CO/O_2		Hours
Residential storage								
Family house (HDG)	Spruce, ENplus	7	Fresh	X	X	CO		2
Office building (KWB)	Spruce, ENplus	15	6 months	X	X	CO		1
Office building (HDG)	Spruce, ENplus	15	Fresh	X	X	CO		1
Public building (HDG)	Spruce, ENplus	60	Fresh	X	X	CO		1
Silo								
Laxå	Pine spruce mix	3000	Fresh	X	X	X	X	3
Flat storage								
Amagerværket	Straw	2000	6 months	X		X	X	1
Løgumkloster	Spruce	500	6 months	X		X		1
	Spruce	2500	2-3 weeks	X		X	X	3

Table 4: Published and planned publications in peer reviewed journals

#	DOI	Title	Author(s)	Journal	Volume/ Issue	Date of publication
1	http://dx.doi.org/10.1016/j.fuel.2014.05.088	Direct measurements of thermal properties of wood pellets: Elevated temperatures, fine fractions and moisture content	Johan Sjöström and Per Blomqvist	Fuel	134	15.10.2014
2		A multivariate analysis of the relationship between the fatty and resin acid contents of wood pellets produced on pilot and industrial scales and their emissions of volatile organic compounds, CO, CO2, and CH4	Elizabeth Valencia-Reyes, Mehrdad Arshadi* and Paul Geladi	Biomass & Bioenergy		2015 (planned)
3		Green extraction technologies for the production of safer wood pellets for heat and power	Elizabeth Valencia-Reye, Thomas M. Attard, Andrew J. Hunt,* Vitaliy L. Budarin, Mehrdad Arshadi and James H. Clark	Fuel		2015 (planned)
4		Influence of the chemical compostion and mineral content on biomass ignition temperature and reactivity during thermochemical decomposition	Annett Pollex, Frank Döhling	Analytical and applied pyrolysis		07.2015 (planned)
5		The influence of oxygen availability on off-gassing rates of emissions from stored wood pellets	Franziska Meier et al.	Energy & Fuel		07. 2015 (planned)
6		A study on the connection between the self-heating and the off-gassing properties of wood pellets	Waltraud Emhofer et al.	Fuel		08.2015 (planned)

Table 5: Published publications in conference proceedings

#	Title	Author(s)	Proceedings	Date of publication	Start Date	End Date	Publisher
1	CO aus Holzpellets- Bildung, Charakterisierung und Massnahmen	Emhofer, W., Aigenbauer, S.	12. Holzenergie-Symposium	14.09.2012	14.09.2012	14.09.2012	ETH Zürich
2	Assessment of self-heating potential of wood pellets	Larsson, I., Lönnermark, A., Blomqvist, P., Persson, H., Rahm, M.	Eco-Tech 2012, Book of Abstracts	28.11.2012	26.11.2012	28.11.2012	Linneaus University
3	Correlation between CO off-gassing and linoleic fatty acid content of wood chips and pellets	Emhofer Waltraud	21 st European Biomass Conference	06.06.2013	02.06.2013	07.06.2013	European Biomass Conference
4	Small scale screening tests to assess the self-heating potential of wood pellets	Larsson, I., Lönnermark, A., Blomqvist, P., Persson, H., Rahm, M.	Interflam	25.06.2013	24.06.2013	26.05.1013	Interscience Communications
5	Temperature Measurements and Examination of self-heating in large scale storage of wood pellets	Ida Larsson, Anders Lönnermark, Henry Persson and Per Blomqvist	World Bioenergy 2014	27.06.2014	03.06.2014	05.06.2014	Swedish Bioenergy Association