

# Environmental Technology Verification



## Statement of Verification

<b>Technology type</b>	Heat exchange system	
<b>Application</b>	Reduced ammonia emission from broiler housing systems	
<b>Technology name</b>	Agro Clima Unit	
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DANETV, The Danish Centre for Verification of Climate and Environmental Technologies, undertakes independent tests of environmental technologies and monitoring equipment.

DANETV is a co-operation between five technological service institutes, DHI, Danish Technological Institute, FORCE Technology, DELTA and AgroTech. DANETV was established with financial support from the Danish Ministry of Science, Technology and Innovation. Further information is available at [www.etv-denmark.com](http://www.etv-denmark.com).

AgroTech undertakes verification of environmental technologies for the agricultural sector. The verifications and tests are planned and conducted in accordance with the guidelines for the ETV pilot Program established by the European Union. This verification statement summarizes the results from verification of the Agro Clima Unit, which is marketed and sold in Denmark by Rokkedahl Energi Aps.

### Description of technology

The technology evaluated was an Agro Clima Unit (ACU) Clima<sup>+</sup> 200, type 2.5 developed by the company Agro Supply and sold in Denmark by Rokkedahl Energy. Broiler production involves a high energy requirement due to a high temperature requirement of newly hatched chicken. The Agro Clima Unit is a heat exchange system that by a countercurrent heat exchange system utilizes the thermal energy of air leaving the broiler house to heat and dry incoming air. The potential ammonia emission reducing principle of the Clima Unit is the drying of the manure layer caused by the heat exchange system and the continuously circulation ventilation in the broiler house.

The Clima Unit is normally situated next to the poultry house (Figure 1). Inlet air is drawn through the Agro Clima Unit to the ridge of the broiler house and distributed to the front and back side of the building by means of four additional in-house supporting vents. This results in an improved distribution of in-house air.

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Figure 1. Picture of the Agro Clima Unit situated outside the test broiler section. Ventilation air to and from the broiler house are drawn through the Agro Clima Unit by a counter current principle to utilise the heat content of ventilation air to heat up inflowing air.

## Application of technology

The Agro Clima Unit is intended for poultry housing systems. The intended application of the Agro Clima Unit technology is defined in terms of the matrix, the purpose and exclusions of the technology application. The matrix is the type of material that the technology is intended for. The purpose of a technology is defined in terms of what measurable properties that are affected by the technology and how these properties are affected.

<b>Matrix</b>	The Agro Clima Unit was verified for the following matrix: <ul style="list-style-type: none"><li>• Ventilation air from broiler housing system.</li></ul>
<b>Purpose</b>	The purpose of the Agro Clima Unit was: <ul style="list-style-type: none"><li>• Reduced ammonia emission from broiler housing systems with Agro Clima Unit installed as part of the ventilation system compared with similar broiler housing systems without Agro Clima Unit installed.</li></ul>
<b>Exclusions</b>	Other emissions parameters were not quantified during this test, even though concentrations of CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O in air inlet and outlets were measured during the test period. Reduction of energy requirement for heating by use the Agro Clima Unit was not quantified by this test.

## Description of test

The overall principle for testing the performance of Agro Clima Unit (ACU) was to compare the emission of ammonia from a test section attached an Agro Clima Unit (case section) and an equal test section without an Agro Clima Unit (Control section). As broilers were housed in a mechanically ventilated housing system, the emission was measured by simultaneously measurements of ventilation rate and concentration of ammonia in ingoing and outgoing air.

Emission measurements require measurement of the air exchange (ventilation) of the housing system. The ventilation rate was continuously on-line measured by anemometers (Stienen 600) situated in ventilation ducts during the test periods.

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Concentrations of ammonia in ingoing and outgoing air were continuously on-line measured by use of an on-line automatic photo-acoustic multigas analyser (INNOVA, 1412). The ammonia emission from both case and control sections were measured over three full production cycles each lasting approximately 30 days. To incorporate the yearly climatic change, the production cycles were placed in the warm and cold seasons. One of the production cycles took place in the summer period; one took place in the autumn period, and one in the winter period. The three production cycles took place from August to December. Ammonia was the primary performance parameter of the test. In addition, a number of operational parameters were measured during the test periods.

### Verification results

The daily ammonia emission from broilers produced in houses with or without the ACU system is shown in Figure 2. Levels of emission were found to increase during the production cycle for all three periods. In period 1 ammonia emission was found to be lower from the broilers produced in the test section attached the ACU system for the first 20 days of the production cycle. In period 2 lower emission from the test section attached the ACU was observed during the full period of measurement. In period 3 lower emissions was observed from the case section during the first 25 days. The highest effect of the ACU system was found when ventilation of the case section was performed mainly by the ACU system. In general it was observed that the higher proportion of the total ventilation requirement that was performed by the roof ventilation system, the closer were the emission levels of the test and case section (Figure 2).

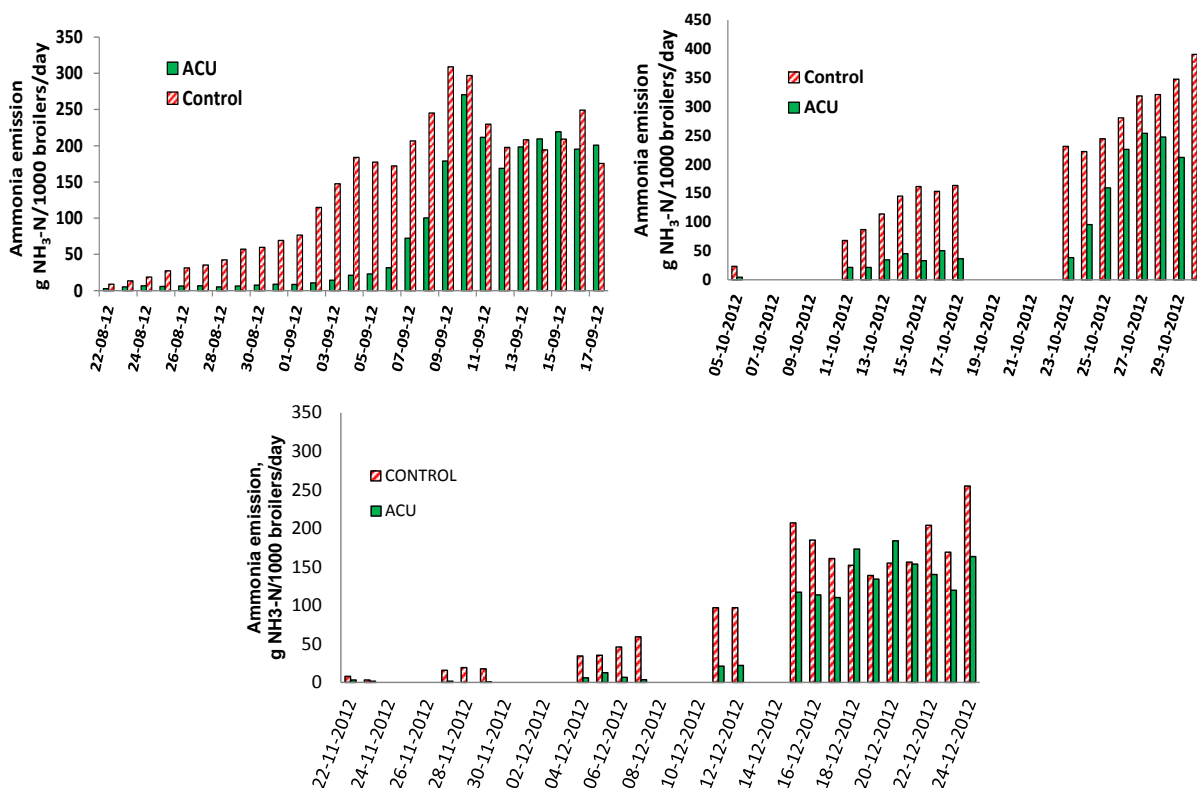


Figure 2. Measured daily emission of ammonia nitrogen (NH<sub>3</sub>-N) from broilers produced in a test section with the Agro Clima Unit (ACU) installed and a test section without use of the ACU system (Control). Ammonia volatilization is shown in g of ammonia nitrogen (NH<sub>3</sub>-N) per 1000 broilers per day. The top left diagram shows results for broilers produced during August and September. The top right diagram shows the results during October to November. The lower diagram shows results for broilers produced during November and December. Missing data is a consequence of malfunction of measurement equipment.

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The total ammonia emission per 1000 broilers produced in a housing system with and without use of the ACU system can be seen in Table 1. The ACU system was found to reduce ammonia emission from broilers by 42 % in period 1, by 49 % in period 2 and by 33 % in period 3. In average the ammonia emission reduction is found to be 41 %.

*Table 1. Measured ammonia volatilization and the ammonia reduction effect of the Agro Clima Unit (ACU) system per 1000 broilers produced in a 30 days production period.*

Test period	Ammonia loss	Unit	Control	ACU	Difference, kg	Difference, %
1	Ammonia loss	Kg NH <sub>3</sub> /1000 broilers	5.07	2.96	2.11	41.6
	Ammonia-N loss	Kg NH <sub>3</sub> -N/1000 broilers	4.18	2.44	1.74	41.6
2	Ammonia loss	Kg NH <sub>3</sub> /1000 broilers	7.01	3.59	3.41	48.7
	Ammonia-N loss	Kg NH <sub>3</sub> -N/1000 broilers	5.77	2.96	2.81	48.7
3	Ammonia loss	Kg NH <sub>3</sub> /1000 broilers	3.84	2.58	1.26	32.7
	Ammonia-N loss	Kg NH <sub>3</sub> -N/1000 broilers	3.16	2.12	1.04	32.7
Mean of the periods	Ammonia loss	Kg NH <sub>3</sub> /1000 broilers	5.30	3.04	2.26	41.0
	Ammonia-N loss	Kg NH <sub>3</sub> -N/1000 broilers	4.37	2.50	1.87	41.0

This test was planned and conducted to comply with the methodologies described in the Test Protocol for Livestock Housing and Management Systems developed under the VERA-program. The intention is that the results of this DANETV verification of Agro Clima Unit can be used as part of the documentation needed for a VERA verification statement.

Further information about the methodology and the results of the performance test is included in the verification report and test report made by AgroTech for Rokkedahl Energi Aps.

### Quality assurance

The test and verification have been performed according to the AgroTech Test Centre Quality Manual. As a part of the quality assurance an internal and an external technical expert provided review of the planning, conducting and reporting of the verification and tests.

Original signed 03.05.2013	03.05.2013	Original signed 03.05.2013	03.05.2013
Signed by Gunnar Hald Mikkelsen Management representative	Date	Signed by Amparo G Cortina Verification responsible, AgroTech	Date

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