

European Commission  
Directorate General for Health and Consumers

## **Study on various methods of stunning for poultry**

Framework Contract for evaluation  
and evaluation related services - Lot 3: Food Chain

### **Final report**

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Prepared by the Food Chain Evaluation Consortium (FCEC)  
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## **S1. Executive summary**

Under Article 27(3) of Regulation (EC) No 1099/09, the Commission must report to the European Council and the Parliament on the various stunning methods for poultry no later than December 8, 2013. In 2004, the European Food Safety Authority (EFSA) recommended that water bath stunning of poultry be phased out on the basis that the live shackling of birds is detrimental to animal welfare and that birds are occasionally not stunned prior to slaughter using this method (EFSA, 2004).

In order to meet the requirements of Regulation (EC) No 1099/09 and to address the EFSA recommendation, DG SANCO launched a study on the various methods of stunning poultry. The contract was awarded to the Food Chain Evaluation Consortium under the leadership of Agra CEAS Consulting. The purpose of the work was to investigate the scale of the use of multiple-bird water bath stunners, the possible alternatives and their respective socio-economic and environmental impacts. Additionally, the study had to examine if phasing out the use of water bath stunning as recommended by EFSA is a feasible option and, if so, under which terms. The study was limited in scope to the following species: broilers, laying hens, parent stock, turkeys and turkey parent stock.

The study was carried out during the calendar year 2012. Data to address the issues of the study were primarily collected through a literature review, semi-structured stakeholder interviews<sup>1</sup>, case studies in nine Member States and three different surveys (industry, Competent Authority and slaughterhouse). The study followed the classical study steps of structuring, observing, analysing and judging.

### **S1.1. Structure and characteristics of the EU slaughterhouse sector**

It is estimated that there are around 5,300 commercial slaughterhouses in the EU, the majority of which are found in France. Where available, data on slaughterhouse capacity suggest significant differences between Member States in terms of individual capacity. This is reflected by the concentration of slaughterhouse sectors within Member States with a highly concentrated sector in some Member States such as Germany, the Netherlands and Italy and a less concentrated sector in other Member States such as Spain, Poland and Hungary. EU slaughterhouses slaughtered around 5.81 billion broiler chickens and had an estimated economic output between €30.6 to €32.5 billion in 2011.

It was estimated that some 16,000 staff handle live birds across the EU at present. Approximately half of these work in Member States where formal training is required by national law. Just under half work in Member States where there are no formal training requirements, though it is probable that on the job training is provided in some of these Member States.

### **S1.2. The use of different stunning systems**

The majority of poultry in the EU is stunned using multiple bird waterbaths. More precisely:

- 81% of **broilers** are stunned using waterbaths, and 19% using CAS;

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<sup>1</sup> Interviewees included industry representatives, Third Countries, Competent Authorities, NGOs, independent experts and equipment manufacturers.

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- 83% of **end of lay hens** are stunned using waterbaths; 7% using CAS<sup>2</sup>;
  - 61% of **parent stock** using waterbaths, and 37% using CAS; and,
  - 76% of **turkeys** are stunned using waterbaths, and 24% using CAS.

CAS systems are generally only used in EU-15 Member States (with the exception of one CAS plant for turkeys in Romania) and tend to be concentrated in just a few Member States, most notably (in descending number of birds): Germany (where 60% of broilers and 40% of turkeys are stunned using CAS); UK (36% of broilers and 95% of turkeys); Italy (30% of broilers and 20% of turkeys); Netherlands (22% of broilers); Finland (90% of broilers); Austria (65% of broilers); Sweden (35% of broilers); and, Belgium (25% of broilers).

The most important driver behind the choice of stunning system is installation and running cost which is cheapest for waterbath systems. Product quality and revenue is also important with certain stunning systems providing quality advantages for specific end markets which often result in higher revenue, for example for breast fillets resulting from CAS stunning. Other drivers of system choice include access to capital and slaughterhouse size with CAS systems requiring higher investment costs and being most cost effective at higher throughputs. Working conditions are generally better in CAS systems where birds are shackled whilst unconscious. CAS systems tend to require less labour and hence are more common where labour costs are high; they are also more common where animal welfare concerns (expressed directly by consumers or indirectly by food business operators) are greater. CAS systems require more space than waterbath systems and may therefore require modifications to the slaughter line and the building which sometimes constitutes a barrier to uptake. Finally, with the exception of Germany, CAS is generally not accepted for religious slaughter. This may lead slaughterhouses which wish to produce partly or wholly for religious markets to use waterbath stunning. The drivers identified above tend to explain both historical and forward looking trends in the relative popularity of the different stunning systems.

### **S1.3. Baseline**

At present, Directive 93/119/EC is in force. As of 1 January 2013, Regulation (EC) No 1099/2009 will enter into force. With the entry into force of this Regulation, the baseline will change. Changes to the baseline at EU level from 1 January 2013 will include:

- The specification of minimum currents;
- Layout and recordkeeping requirements for new slaughterhouses;
- Certificate of competence needed by staff handling live birds (entry into force of provisional requirements), and;
- Self checking obligation and the presence of an animal welfare officer

There will be further changes to the baseline on 8 December 2015, when full requirements for the certificate of competence will enter into force, and 8 December 2019 when layout and recordkeeping requirements will apply to existing slaughterhouses as well as new ones.

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<sup>2</sup> Figures do not add up to 100% as a proportion of birds have been identified as being slaughtered using other methods, most notably on-farm slaughter. The situation is similar for parent stock.

While Regulation (EC) No 1099/09 will determine the baseline at EU level, there may be some differences between individual Member States in terms of the baseline going forwards. However, given that the Regulation is not yet in force, it is difficult to identify differences in the baseline with certitude. Significant differences between Member States in terms of legislation were not identified; while four Member States (CZ, DE, DK and LV) indicated that they may introduce measures which go beyond the Regulation, details of these measures had not yet been decided. A fifth Member State, SE, already has measures which go beyond the Regulation but these extra measures were judged to have a minor impact on the baseline.

The implementation of the Regulation, rather than additional legislation at national level, was identified as being a more likely source of differences in the baseline between Member States. Potential differences in implementation were identified in relation to: the derogation for religious slaughter; the certificate of competence; and the measurement and recording of parameters. Of these three potential differences in implementation, the religious slaughter derogation potentially has the biggest impact. Depending on the exact interpretation and implementation of this derogation (whether or not stunning with parameters below those set out in the Regulation is allowed for religious slaughter, and how exactly this is controlled), it may be possible for operators in some Member States to circumvent the electrical parameters requirement when producing for the wider market. Evidence suggests that interpretation and implementation of the Regulation which potentially allows operators to circumvent the parameters may eventually be adopted by up to half of Member States in a worst-case scenario. With regard to the issue of implementation of the certificate of competence, it was considered that requirements for the certificate may differ between Member States, potentially disadvantaging operators in Member States with more stringent requirements. Nonetheless, experience with the certificate of competence for animal transport suggests that this may not be a significant problem. With regard to the issue of the measurement and recording of parameters, concerns were expressed about the lack of clarity more than about possible impacts of differential implementation.

Private initiatives containing provisions on poultry slaughter were identified in four Member States (UK – RSPCA; NL – Beter Leven; SE – Svensk Fägel; FR – Label Rouge), with a scheme under development in a fifth Member State (DE – Deutscher Tierschutzbund). It was also identified during the study that some multiple retailers and food service companies either have preferences for certain stunning methods, or requirements relating to particular aspects of the stunning process (such as the electrical parameters used). These companies were generally based in north-western Member States.

#### **S1.4. Impacts of the baseline**

In terms of **animal welfare impacts**, it was estimated that the entry into force of electrical parameters would lead to an improvement in welfare for 1.31 billion broilers (23% of broilers slaughtered annually in the EU) due to an effective stun. The requirement for an animal welfare officer could have positive animal welfare in Member States without such a requirement at present; these Member States represent 75% of total EU production.

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Three main sources of **economic impact** were identified. These were the layout requirements, stunning parameters, and requirement for an animal welfare officer. The layout requirements, which enter in to force in 2019 for existing slaughterhouses, were found to have greater impacts on slaughterhouses with waterbath systems than those with CAS systems. The exact level of changes required in order to comply with layout requirements, and the costs of these varied considerably. In the case of minor changes, the cost of compliance was judged to be a few thousand euros. In the case that a new system has to be installed in order to comply, the costs could reach several million euros. It is difficult to judge the proportion of slaughterhouses which require different levels of changes in order to comply with layout requirements, though evidence suggests that two thirds of slaughterhouses will need to make some kind of change. Evidence also suggests that a little over a quarter of slaughterhouses needing changes (just under 20% of all slaughterhouses) will require entirely new systems. Three specific layout requirements were identified as being particularly challenging to comply with in some cases. These were:

- One minute hang time prior to stunning;
- A device for recording the electrical parameters used, and;
- The requirement to access birds on the slaughterline.

Very little research has been conducted into the economic impact of the electrical stunning parameters in the Regulation. The issue of quality was unfortunately not examined by EFSA during their investigation into the effectiveness of stunning using different parameters, and there is no comprehensive, up-to-date independent literature on the subject. Based on limited evidence available, the loss per bird due to downgrading under the parameters of the Regulation was estimated to be in the range of 0.7 to 2.0 cents per bird (and possibly up to 3.1 cents if trims cannot be sold). Due to the structure of the market, the losses above are likely to affect around 50% of the waterbath production, i.e. 2.35 billion broilers.

The requirement for an animal welfare office was identified to have a minor economic impact, the magnitude of which will depend on several factors including the wage paid, the precise implementation of this role, and the throughput of the slaughterhouse.

Finally, some **further impacts** of the baseline were identified. The risk of competitive distortion within the EU should be reduced as a result of the entry into force of the Regulation. Given the Regulation will also apply to Third Country operators which sell on the EU market, EU operators are not likely to be significantly disadvantaged domestically. However, EU operators are likely to become less competitive on export markets, primarily for reasons of market access. The introduction of the Regulation may have some social impacts, most notably on regional employment and religious groups, though the extent of these impacts will depend on the implementation of the Regulation. Changes in environmental impacts resulting from the entry into force of the Regulation will be negligible.

### **S1.5. Other stunning systems under development**

Waterbath stunning and Controlled Atmosphere Stunning are the only commercial systems in operation. Although a number of alternative systems are under development, most of these are not



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considered to be near commercialisation. Only a head-only stunning system and a Low Atmosphere Pressure Stunner (LAPS) appear to be close to commercialisation. One head-only stunning system is in operation in a commercial slaughterhouse, although it has not been purchased and hence cannot be considered to be fully commercialised. The LAPS system is in commercial operation in a slaughterhouse in the US. Both these systems target medium to large slaughterhouses.

In addition to alternative stunning methods, research into some improvements to waterbath stunning has been undertaken to address specific animal welfare concerns, with one of the resulting innovations in operation in two small scale commercial slaughterhouses.

### **S1.6. The cost of different stunning methods**

The costs of stunning systems were compared through a cost model using a number of simplifying assumptions where necessary.

The following factors were included in the cost model:

- installation cost depreciated over a 10 year period;
- annual maintenance cost;
- labour for reception and hanging, and other labour used in the stunning process;
- water for stunning and cleaning;
- electricity for stunning; and,
- gas for stunning;

The main data sources used were:

- aggregated estimates of equipment manufacturers (45% weighting);
- results of the slaughterhouse survey (45% weighting); and,
- data from literature and other sources (10% weighting).

Waterbath stunning was found to be the cheapest stunning method, and CAS the most expensive. The highest cost difference between waterbath and CAS is around 1.5 cents per bird. However differences vary depending in particular on the throughput and the local price of the different inputs and in particular labour cost. Slaughterhouses with low throughputs (3,000-6,000 birds per hour) present the largest costs difference compared to slaughterhouses with high throughput (12,000 birds per hour with a difference of around 1 cent). The cost of LAPS and head-only stunning were found to fall between those of head-only stunning and CAS, though given the lack of data from commercial operations for these systems, cost estimates for these should be treated with caution. Waterbath stunning showed a greater relative advantage over other methods where unit input costs are lower. The relative gap between the cost of waterbath stunning and other methods was found to narrow where input costs, principally labour, are higher. CAS was found to become more expensive relative to other methods on a per bird basis as throughput falls.

The impact on revenue of different stunning systems is highly dependent on the end market. Three potential mechanisms for higher revenue were identified: access to higher value markets; higher revenue for better quality; and, reduction in losses through trimming and the cost of trimming. There

has been very limited investigation into the impact of different stunning methods on quality. Evidence generally suggests that damage to breast and leg meat is higher with waterbath stunning. In contrast, damage to wing tips and skin is generally lower with waterbath stunning. In view of the limited information on quality coupled with the strong influence of end markets on revenue, it was not possible to make generalisations for the different systems. However, the impacts for two scenarios (whole bird and fresh breast fillet market) were analysed. In the case of the whole bird market, no significant difference in revenue was found between stunning systems. In the case of the fresh breast fillet market, it was estimated that losses through trimming and downgrading of the breast could be between €0.011 and €0.052 per bird. However, to benefit from this potential additional revenue it is necessary to have access to these higher value markets (and end markets tend to determine stunning system and not vice versa). Also, the level of any premium will be a function of supply and demand, and while CAS remains the minority system, this premium will remain higher. If CAS becomes more widely used, one would expect this premium to fall. Finally, slaughterhouses producing for the fresh breast fillet markets will also need to find a market for the rest of the carcass, including cuts which are normally exported due to low domestic demand. If it is not possible to find a market for the entire carcass, e.g. due to the non-acceptance of this meat in religious markets, the breast fillet will have to support the cost of production of the other cuts and the premium will fall accordingly.

Some other differences between stunning systems which fell outside the cost model were identified. Most notably:

- CAS systems were found to require more space than waterbath systems. As a result the building and structural modification costs are likely to be higher for CAS than for waterbath stunning.
- The working environment is more pleasant with CAS (and LAPS) systems due to the absence of live shackling. This may in turn have positive economic impacts through lower employee turnover.
- On balance, there would appear to be little between CAS and waterbath systems in terms of environmental impacts. CAS offers advantages over waterbath systems in terms of dust/odour, waste and water. Waterbath systems offer advantages over CAS systems in terms of electricity usage and greenhouse gases.

### **S1.7. The feasibility of phasing out multiple bird waterbath stunners**

It is considered that, under the baseline, there will be a slight reduction in the use of waterbath systems and increase in the use of CAS systems in the short-to-medium term (two to five years). It is estimated that the proportion of broilers stunned using waterbaths will fall from 79% at present to around 65%, while the proportion of broilers stunned with CAS systems will increase from 21% to around 35%. There will be significant differences between Member States, with no changes in stunning system in some Member States, and significant changes in others.

Two **voluntary incentives** for phasing out waterbath stunners were identified and examined during the study. These were labelling and financial support for system conversion. There were issues with both of these voluntary incentives. In the case of labelling, evidence suggests it is unlikely that a

labelling scheme will be effective in promoting consumer avoidance of waterbath systems. Furthermore, the precise nature of labelling would need to be determined (food business operators were against the explicit mention of slaughter on the packaging of meat) and the costs of traceability and assurance would need to be investigated. Financial incentives may be partially effective in phasing out waterbath stunning in the case that investment cost is the major barrier to the use of alternative systems. Other voluntary approaches or initiatives such as providing best practice guides and financing for innovation in order to improve existing systems are further potential options. While these are unlikely to help with encouraging a significant move away from waterbath systems, they may be worth examining in further detail due to the potential positive impacts on animal welfare they could have.

The issue of a complete or partial **mandatory phasing out of waterbaths** was examined through a PESTLE analysis<sup>3</sup>. On balance, a complete mandatory ban on waterbaths was considered difficult. There would be positive aspects of a ban; from a political perspective, it would bring the industry into line with the 2004 recommendation of EFSA, and in social terms there would be a positive impact on animal welfare. However, there were considered to be significant potential negative impacts and problems. Mandatory phasing out would have strong economic impacts on operators, and these would be accentuated for smaller slaughterhouses due to the technological issue of the current lack of commercial alternatives to waterbath stunning systems. It may also be difficult to make changes to a regulatory framework which was only recently modified and still has to enter fully into force. Furthermore, there may be some negative social impacts if consolidation in the sector were to accelerate as a result of such a mandatory phasing out.

There are several theoretical options for the partial phasing out of waterbaths. These include: partial bans by slaughterhouse capacity, species and end market; a partial ban for new slaughterhouses; and various combinations of the above. While partial options address some of the potential problems of a full ban (e.g. a partial ban by slaughterhouse capacity addresses the issue of the lack of technological alternatives for smaller slaughterhouses), they may also introduce other problems. The main potential additional problems relate to the political case for differential treatment, and the legal issues associated with defining and effectively implementing partial bans. Of the options which include a partial ban, the most feasible would appear to include a partial ban for new slaughterhouses, possibly in conjunction with other aspects such as a cut-off capacity for the ban. Nonetheless, other issues would have to be examined prior to the introduction of such a partial ban, most notably how this partial ban would be transformed into a full ban over time. On balance, and taking into account the imminent entry into force of Regulation (EC) No 1099/99, it is recommended that no further action in terms of a ban be taken at this point in time. The use of stunning systems should, however, be monitored against the background of the Regulation over a period of three to five years in order to confirm the evolution of the use of systems and to consider the development of further alternatives.

Finally, in view of the recommendation that no further action be taken, indicators for monitoring and evaluating the future situation were developed. These included:

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<sup>3</sup> Political, Economic, Social, Technological, Legal and Environmental.

- A context indicator to allow an understanding of the structure of the sector in terms of the number of poultry slaughterhouses, the stunning systems used and their throughput. This could be requested by Member States, and could be used to measure the current situation and the potential for policy change rather than to measure policy improvement.
- A context indicator to measure the near-commercial availability of alternative systems. In the case of the emergence of a near-commercial alternative system, and prior to any legislative changes, a comparison of the costs of these systems against existing commercial systems should be made for different size slaughterhouses.
- A result indicator to record stunning parameters used in electrical waterbath systems; this could build on the requirement already in the Regulation. Such a practice would allow more meaningful statistics on stunning by species to be collated.
- A result indicator to measure the impact of different stunning parameters on product quality.
- An output indicator to measure progress towards compliance with legislation post-2019.

## **1. Introduction**

Under Article 27(3) of Regulation (EC) No 1099/09, the Commission must report to the European Council and the Parliament on the various stunning methods for poultry no later than December 8, 2013.

In 2004, the European Food Safety Authority (EFSA) recommended that water bath stunning of poultry be phased out on the basis that the live shackling of birds is detrimental to animal welfare and that birds are occasionally not stunned prior to slaughter using this method (EFSA, 2004).

In order to meet the requirements of Regulation (EC) No 1099/09 and to address the EFSA recommendation, DG SANCO launched a study on the various methods of stunning poultry. The contract was awarded to the Food Chain Evaluation Consortium under the leadership of Agra CEAS Consulting. The purpose of the work is to investigate the scale of the use of multiple-bird water bath stunners, the possible alternatives and their respective socio-economic and environmental impacts. Additionally, the study will examine if phasing out the use of water bath stunning as recommended by EFSA is a feasible options and, if so, under which terms.

## **2. The current situation regarding poultry stunning in the EU**

### **2.1. The EU poultry meat sector**

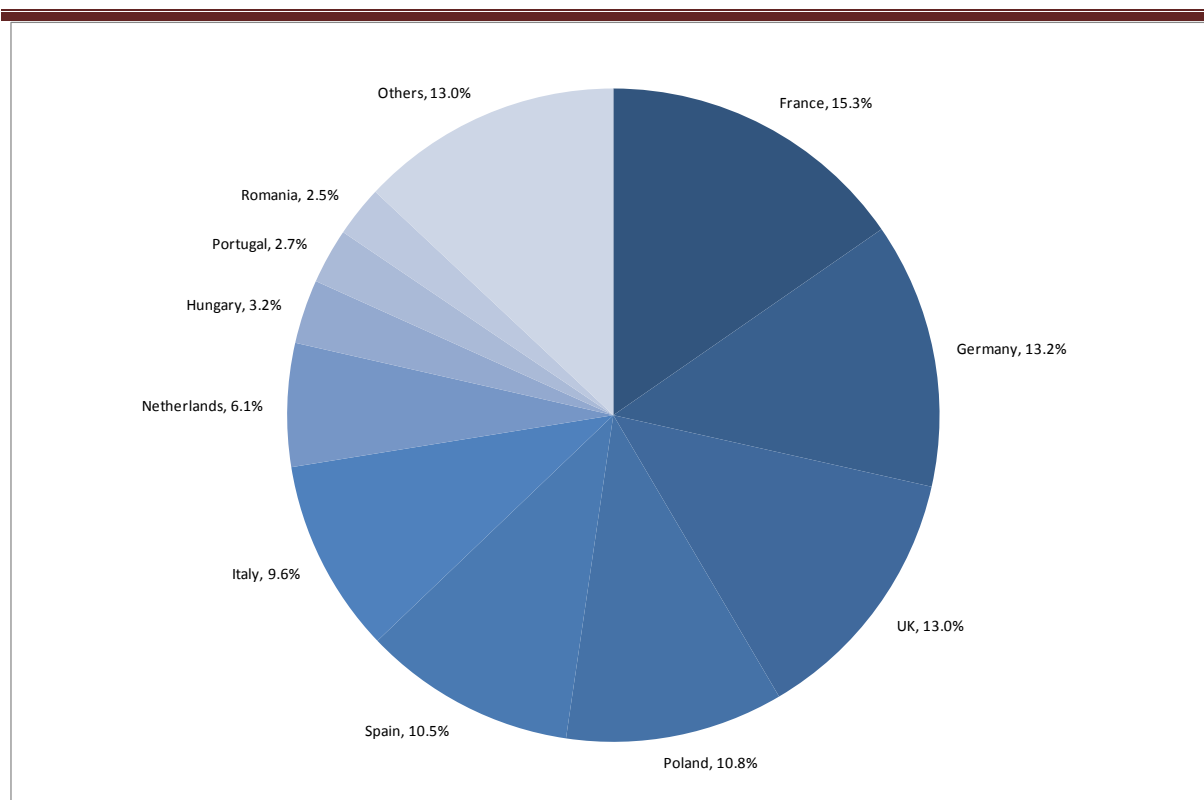
This section contextualises poultry meat production in the EU and sets out the evolution of consumption, self-sufficiency and trade.

#### **2.1.1. Production**

EU poultry meat production amounted to 12.1 million tonnes in 2010 carcass weight (AVEC, 2011), making it the second most produced meat by weight after pork (22.0 million tonnes carcass weight), and ahead of bovine meat (7.9 million tonnes)<sup>4</sup>. As Figure 2.1 illustrates, the main producers in the EU are France (1.9 million tonnes, 15.3% of total production), Germany (1.6 million tonnes, 13.2%), UK (1.6 million tonnes, 13.0%), Poland (1.3 million tonnes, 10.8%) and Spain (1.3 million tonnes, 10.5%). Some 78% of EU poultry meat is produced in the EU-15.

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<sup>4</sup> Source for pork and bovine production: Eurostat, 2010. Figure for bovine meat production considered provisional. Figure for pork production is provisional and excludes Bulgaria, for which 2010 production figures are not currently available.



**Figure 2.1: Major EU poultry producers, 2010**

Source: AVEC, annual report 2011.

EU poultry meat production increased gradually between the mid-1990s and 2007, with only a few interruptions, most notably:

- **1999:** food safety scares, cutbacks in production in France and Avian Influenza (AI) outbreaks in Italy caused a temporary decrease in production;
- **2003:** major AI outbreak resulting in production cuts in France, Italy, Benelux and Sweden;
- **2005:** the accession of ten new Member States to the EU increased total production by 19%, approximately half of which was located in Poland; and,
- **2007:** the accession of Bulgaria and Romania added a further 0.4 million tonnes to total EU production.

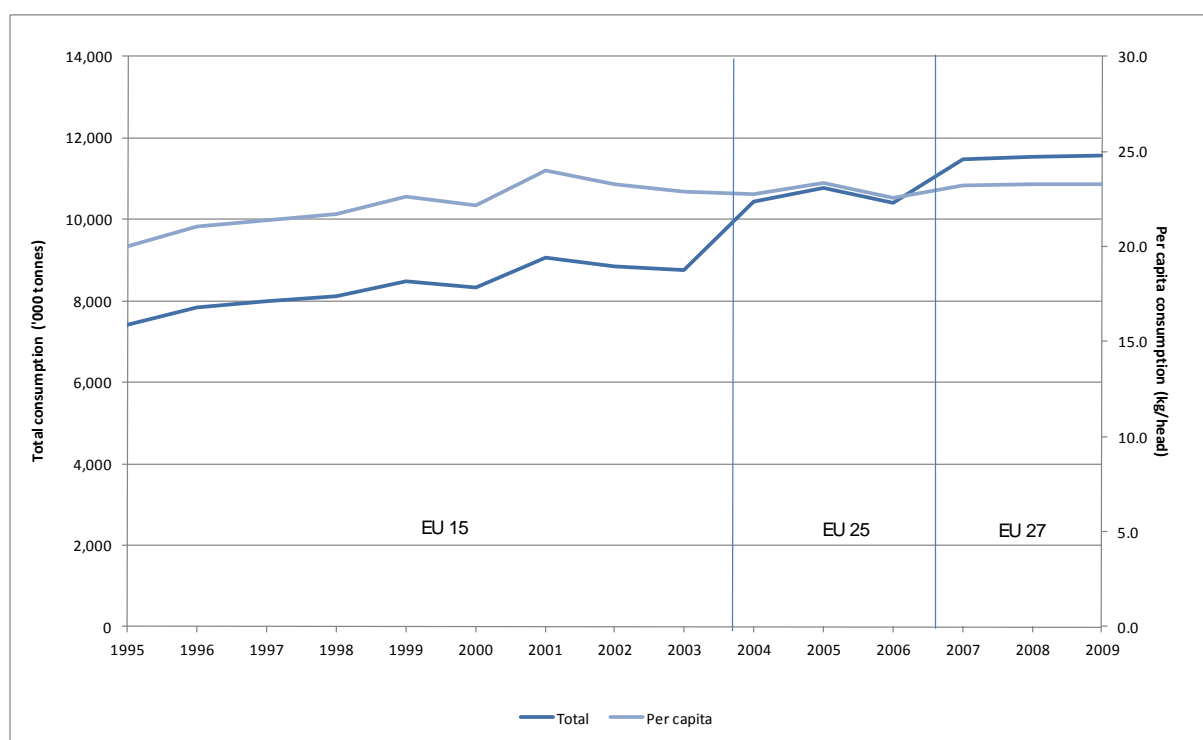
Total annual production has remained more or less stable at around 11.5 million tonnes since 2007.

Broiler production can be either integrated with vertical coordination of the supply chain through contracts as is generally the case in France, Germany, Italy and Spain; or non-integrated, where each stage of the production chain is operated independent of the others, for example in the Netherlands, Belgium and Poland<sup>5</sup>.

<sup>5</sup> See Agra CEAS Consulting (2010) and Agra CEAS Consulting (2011) for further descriptions of integrated and non-integrated production systems.

### 2.1.2. Consumption and EU self-sufficiency

Consumption in 2009 stood at 11.6 million tonnes. In terms of historical evolution, increases in per capita consumption within the EU-15 between 1995 and 2001, driven in part by the BSE crisis in the beef sector, lifted total consumption from 7.4 million tonnes to 9.0 million tonnes (Figure 2.2). The main cause of increase in total consumption of poultry meat in the EU since 2001 has been enlargement in 2004 and 2007. The 2004 enlargement increased total poultry meat consumption by 20.5% and the 2007 enlargement by a further 4.2%. Per capita consumption has remained relatively stable since 2004 at around 23 kg/head which is a little lower than the 2001 peak.



**Figure 2.2: Total consumption ('000 tonnes) and per capita consumption (kg) in the EU, 1995 – 2009**

Source: European Commission.

The level of self-sufficiency in the EU has steadily decreased from 108.5% in 1995 to 100.9% in 2009, largely the result of the accession of new Member States.

### 2.1.3. Trade

According to data from Comext and the 2011 AVEC annual report, the EU exported 1.125 million tonnes of poultry meat in 2010<sup>6</sup>, while 0.707 million tonnes were imported<sup>7</sup>. These figures represent

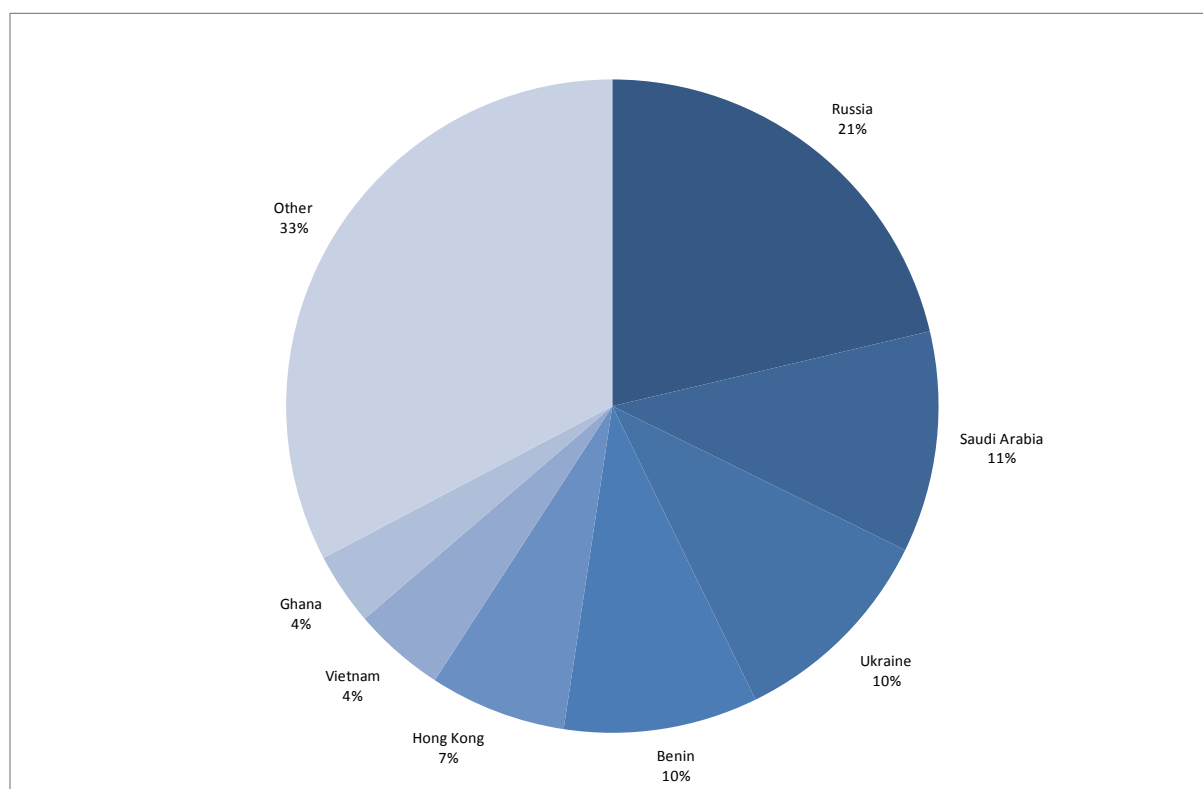
<sup>6</sup> Under CN code 0207: meat and edible offal of poultry.

<sup>7</sup> Some 0.167 million tonnes were imported under 0207 according to Comext; AVEC estimates that 0.194 million tonnes of salted poultry were imported under CN code 0210 99 39, and 0.346 million tonnes of poultry preparations were imported under 160231..., 160232..., 16023921, 16023929, 16023940 and 16023980.

approximately 9% and 6% of annual EU production respectively. There is a tendency towards the import of breast meat from Third Countries, and exports of lower value cuts which are less popular on the domestic market (i.e. wings, feet, offal); in other words trade is essentially an exercise in carcass balance. However, there are some exports of specialist production, for example, whole birds from France to Saudi Arabia which is supported by export refunds. Data from Comext on the value of trade reflect this. The total value of exports under CN code 0207 was €1.18 billion (an average of €1.05 per kilogram) in 2010, compared to €1.97 billion (an average of €2.48 per kilogram) for imports under the CN codes in footnote 7.

With regard to **imports**, the main origin of Third Country poultry meat is Brazil, which accounted for more than 75% of the total in 2008<sup>8</sup>. The second largest exporter to the EU in 2008 was Thailand, with a 16% share of imports; Chile accounted for 5% and Argentina 2%. While the US would like to export poultry meat to the EU, this is currently prohibited by the EU ban on the anti-microbial treatments (AMTs) which are commonly used in the US.

The EU's main **export** markets in 2008 were Russia, 21% of the total, Saudi Arabia, 11%, Ukraine, 11% and Benin, 10% (Figure 2.3). Although Russia and Hong Kong tend to source the majority of their poultry imports from south-east Asia and South America, their trade with the EU is driven by quality, bilateral agreements, price, and in the case of Russia, specialist production in Brittany.



**Figure 2.3 Main destinations for extra-EU exports of poultry meat, 2008 (%)**

<sup>8</sup> No more recent data are available.



Source: Eurostat.

## 2.2. Structure of the EU poultry slaughterhouse sector

### 2.2.1. Number of slaughterhouses and throughput by slaughterhouse size

There is no single comprehensive list of poultry slaughterhouses in the EU and data by throughput are sparse. The data on poultry slaughterhouses presented below has therefore been collected from various sources during the present study. Table 2.1 provides an overview of the total number of slaughterhouses for all species of poultry in each Member State. The year to which the data refer and its sources are also indicated. According to the data collected, there are approximately 5,300 poultry slaughterhouses in the EU, some 4,000 of which are in France. However, this figure is likely to be an underestimate because many Member States only recorded EU approved slaughterhouses and data for Cyprus, Greece and Luxembourg were not identified.

**Table 2.1: Number of poultry slaughterhouses in each Member State**

MS	Year of data	Source	Total no slaughterhouses	Data on slaughterhouses by throughput available
AT	2012	CA list of establishments	21	N
BE*	2010	Industry statistics	51	Y
BG	2012	CA list of establishments	29	N
CY	2012	DG SANCO	54	N
CZ	2012	CA list of establishments	31	N
DK	2012	AVEC Member	10	N
EE	2012	CA list of establishments	3	N
FI	2012	CA statistics	16	N
FR	2012	Case study	4,000 (approx)	Estimations only
EL	No data identified			
DE	2009	Industry statistics	110	Y
HU	2012	CA list of establishments	85	N
IE	2012	CA statistics	8	Y
IT	2012	Case study	182**	Y
LV	2012	CA survey	2	Y
LT	2012	CA list of establishments	10	N
LU	2012	DG SANCO	0	N/A
MT	2012	CA list of establishments	5	N
NL	2010	Industry statistics	15	Y
PL	2012	CA list of establishments	192	N
PT	2012	CA list of establishments	43	N
RO*	2012	Case study	37	N
SK	2012	CA statistics	8	N
SI	2012	CA list of establishments	6	N
ES	2012	Case study	174	Estimations only
SE	2012	Case study	19	Y
UK	2012	Case study	434	N

<b>EU-27</b>		<b>Various</b>	<b>~5,300</b>	
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Source: various, indicated in the table.

\* Total number assumed to be the sum of slaughterhouses per species.

\*\* There are 182 slaughterhouses for poultry and rabbits on the official register. However the data provided on slaughterhouses by throughput counted 83 slaughterhouses. It was confirmed that the difference was due to a combination of small/seasonal slaughterhouses, and those which slaughtered rabbits rather than poultry.

The terms of reference request that data on the number of slaughterhouses by size category be presented<sup>9</sup>. This is complicated for a number of reasons. First, such data are not recorded in the majority of Member States (as shown in Table 2.1, data are available for seven Member States with estimations in a further two). Second, where data on the number of slaughterhouses by size are available, the presentation of the data varies significantly, both in terms of the size categories and the time period used for the measurement of capacity (birds per hour is the most commonly used metric). Furthermore, it should be noted that, with a few exceptions, data on slaughterhouses by capacity is for all species of poultry, and it is not possible to differentiate by species<sup>10</sup>. Finally, some Member States record actual throughput while others record capacity.

With these difficulties in mind, available data on slaughterhouses by capacity are presented in Table 2.2. Two points should be noted about the data itself:

- where data relate to throughput it has been assumed that this is equal to capacity; and,
- data based on hourly capacity has been converted into monthly capacity using eight hours a day and 22 operating days a month.

In terms of presentation:

- The top row of the table provides a (non-linear) scale of monthly capacity in thousand birds.
- Size categories for each Member State are delimited along this scale through the use of differently shaded regions, and the number of slaughterhouses falling in this capacity range is indicated with a figure. For example, for France there are two shaded regions, one from 0-400, and one from 400 to over 1,000. The figures corresponding to these ranges are 3,944 and 56 respectively. This indicates that there are 3,944 slaughterhouses in France with a capacity of between 0 and 400,000 birds per month, and 56 slaughterhouses with a capacity of over 400,000 birds per month.
- The shades used to delimit categories change from dark (smallest capacity category) to light (highest capacity category).

<sup>9</sup> Using the following size categories expressed in birds slaughtered per month: <200,000, 200,000-<1,000,000 and >1,000,000.

<sup>10</sup> The only Member States with data which can be to an extent differentiated by species are Ireland and Belgium.

**Table 2.2: Data on number of slaughterhouses by size in EU Member States with available data ('000s birds per month)**

Monthly Capacity	0	~10	20	30	~40	50	100	200	400	500	~800	1,000+	
ToR Categories													
BE+	30	6				8					9		
FR*	3,944									56			
DE	55		9			7	6	6		12		15	
IE	4					1	1	1		2		2	
IT	8								44		0	31	
LV	0								1	1		0	
NL**	0								4			11	
ES*	166										6		2
SE++	7	3	1				3				3		

Source: Agra CEAS own elaboration based on various national sources, our survey and case studies.

Note: shaded areas delimit the size category for slaughterhouses. The number inside the area indicates the number of slaughterhouses within this size category. Please see the example of France in the text above for a full explanatory example.

\* Agra CEAS estimation based on various data sources and national estimations.

\*\* Data expressed in tonnes per year; converted to the number of birds by using an average bird weight of 2kg<sup>11</sup>.

+ Broiler slaughterhouses only included; data on laying hens is available separately.

++ Data recorded on annual throughput; conversion to monthly capacities has been rounded.

<sup>11</sup> Average EU broiler weight tends to be around 1.7kg. Average turkey weight around 5kg. Under 10% of poultry production in the Netherlands is turkey.

### 2.2.2. Economic output of the poultry sector

Eurostat compiles prices on the economic output of the poultry sector in basic prices<sup>12</sup>. These data are presented for the EU-27 as a whole and for the nine case study Member States in Table 2.3 below.

**Table 2.3: Economic output of the EU-27 poultry sector and case study Member States, 2009-11; Basic prices, in € million (value at farm gate)**

	2009	2010	2011 (estimate)
Germany	2,001.40	1,861.55	2,166.66
Spain	1,898.89	1,910.28	2,358.01
France	3,036.30	3,086.30	3,579.10
Italy	1,983.67	2,028.57	2,390.98
Netherlands	724.84	749.04	857.27
Poland	1,520.63	1,752.96	2,172.47
Romania	467.15	348.34	389.53
Sweden	120.86	138.71	162.62
United Kingdom	1,784.85	2,097.27	2,092.16
<b>EU-27</b>	<b>16,543.82</b>	<b>17,111.44</b>	<b>19,590.58</b>

Source: Eurostat.

According to Eurostat's definition of the data, the amounts shown in Table 2.3 are the value of poultry at the farm gate, i.e. before any slaughter and processing operations. The economic output of the poultry sector following slaughter and further processing is likely to be significantly higher. There is no one single set of data at the EU level which estimates the economic output of the poultry sector after slaughter and most Competent Authorities reported in our survey that such data are not recorded at Member State level. However, from the few Member States which have such data, it is possible to estimate the degree to which the output of the poultry sector following slaughter will be higher. Data from the French case study (section 1.2 of the Case Study Annex) shows the turnover of French slaughterhouses to be €5,952 million in 2011; some 66% higher than the output in basic prices from Eurostat. Similarly, estimates from the Romanian case study (section 6.2 of the Case Study Annex) show slaughterhouse output to be around €608 million, 56% higher than the output in basic prices from Eurostat. It is therefore assumed that the slaughterhouse value of output from poultry slaughterhouses is between 56% and 66% higher than the value of production at the farm gate.

On this basis, it can be concluded that EU-27 slaughterhouses had an output between €30.6 billion and €32.5 billion in 2011.

Unfortunately there is no readily available data to allow a comparison of the value of slaughterhouse output of the EU poultry sector to that of other livestock sectors. However, data for the lower farmgate value of other livestock sectors is available from Eurostat. Compared to the farmgate output

<sup>12</sup> Defined by Eurostat as: "the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, by the producer as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer".

of the poultry sector of €19.6 billion, the farmgate output of the cattle sector was €31 billion; that of the pigmeat sector was €34.7 billion; and that of the sheep and goat sector was €5.6 billion. This means that the value of the poultry sector (as measured by farmgate prices) is approximately two-thirds the value of the beef sector, just under half the value of the pig meat sector and three and a half times the size of the sheep and goat sector.

### 2.2.3. Level of concentration of the poultry sector

Data on the level of concentration in the poultry sector in different Member States has been collected through our surveys of Competent Authorities and AVEC members. Concentration ratios for slaughterhouses (all poultry species) are presented in Table 2.4 below. Given that not all Member States have replied to the surveys (mainly because this information is sometimes considered commercially sensitive), concentration levels are not available for all 27 Member States. Nonetheless, the data provide an indication of concentration levels for the most significant poultry producing Member States.

**Table 2.4: 4 and 8 firm slaughterhouse concentration ratios (CR-4 and CR-8) in EU Member States**

Member State	Market share of top 4	Market share of top 8	Birds slaughtered in largest 4 SH ('000s)	Birds slaughtered in SH 5-8 ('000s)
Austria	90%	95%	61,051	3,392
Belgium	55%	90%	167,468	106,570
Czech Republic	75%	96%	92,030	25,768
Denmark	96%	100%	101,831	4,243
Estonia	100%		8,745	-
Finland	100%		57,446	-
France	20%	31%	208,467	110,060
Germany	53%	81%	373,678	197,415
Hungary	53%	73%	82,857	31,267
Ireland	87%	100%	61,221	9,147
Italy <sup>13</sup>	~35%	65%	197,446	169,240
Latvia	100%		14,641	
Netherlands	43%	70%	200,494	125,892
Poland	7%	N/A+	49,503	N/A
Romania	31%	53%	56,571	40,147
Slovakia	85%	100%	42,341	7,472
Spain	20%	35%	140,745	105,559
Sweden	86%	100%	68,020	11,114

Source: Survey of AVEC members, Competent Authority survey and case studies (industry figures used in the case of conflict). Number of birds based on figures from Eurostat for 2011 as far as possible.

+ Neither the CA nor industry were able to provide this figure.

<sup>13</sup> Agra CEAS estimations based on data provided by interviewees.

Slaughterhouses data in the UK were not available as this is considered commercially sensitive. However, five poultry processing companies (each with multiple slaughterhouses) own 95% of the processing capacity, suggesting a high level of concentration at the ownership level.

#### 2.2.4. Employment in the poultry sector

Data on employment in slaughterhouses are very limited and there are no data sets concerning the number of employees dealing with live birds. Data identified through this study are presented in Table 2.5 below and are highly variable.

**Table 2.5: Data on poultry slaughterhouse employment in the EU**

Member State	Total employment	Contact with live birds	Source
Denmark	1,450		Industry estimates
France	28,305	-	Case study
Germany	8,717+	-	Employer's Liability Insurance Association
	50,000*	800-1,000	Case study
Italy	17,000		Case study
Latvia	290		CA survey <sup>14</sup>
Netherlands	1,886		Case study
Romania	7,000-8,000	3,000-4,000	Case study
Spain	40,000	2,000	Case study
Sweden	-	100	Case study
U.K.	-	1,000	Case study

Sources: See source column; elaborated by Agra CEAS.

+ Full time equivalent.

\* Includes employment in administration and logistics in slaughterhouses (i.e. is not limited to slaughter related operations).

Given this very limited evidence base, which is compounded by differences in the roles included within the category “slaughterhouse workers”, arriving at a meaningful EU figure for employment in poultry slaughterhouses is not possible. However, it is possible to estimate the number of staff working with live birds in slaughterhouses by building this up from theoretical labour requirements for shackling. According to interviewees, one member of staff can shackle around 1,000 birds per hour<sup>15</sup>. It can therefore be concluded that a slaughterhouse worker who works 8 hours per day, 250 days per year can shackle around 2 million birds per year.

For a Member State such as Germany, this implies that around 350 staff are required for the shackling of birds alone per year; about 40% of the mid-point of the official estimate in Table 2.5, i.e. a ratio of approximately 1 to 2.5. The difference between the estimate and the official number provided can be attributed to two factors. First, there will be some additional staff in slaughterhouses who perform live bird handling operations other than shackling (for example, unloading and slaughter in some cases).

<sup>14</sup> 170 in the larger slaughterhouse and 120 in the smaller slaughterhouse.

<sup>15</sup> The exact speed will depend on the system; shackling with CAS systems is generally considered to be a bit quicker.

Second, the estimate assumes that all staff work full-time, while in reality some staff will work only part-time.

This ratio of difference between our estimations and official data calculated for Germany is similar for the UK and Sweden; slaughterhouse mechanisation and scale are broadly comparable in all three of these Member States. The ratio is greater in Spain (approximately 1 to 5.7), most likely the result of the larger number of smaller slaughterhouses in the country which are likely to be more labour intensive; and significantly higher in Romania (1 to 38.5) where systems are again more labour intensive and there is significant on-farm killing. Extrapolating these ratios for all Member States depending on the structure of the slaughterhouse sector and applying them to the theoretical number of hangers, it is possible to obtain an estimate of the number of people handling birds in slaughterhouses (see Table 2.6). It is estimated that some 16,000 staff handle live birds across the EU-27.

**Table 2.6: Estimates of the number of staff handling live birds in the EU-27**

MS	'000s of birds slaughtered p.a.	Theoretical number of hangers required	Official number	Final figure /estimate	Comments
AT	67,835	34		~85	Ratio used 1:2.5
BE	304,487	152		~380	Ratio used 1:2.5
BG	52,266	26		~160	Use of the ratio for ES due to possible on farm slaughter
CY	13,639	7		~15	Ratio used 1:2.5
CZ	122,707	61		~150	Ratio used 1:2.5
DE	705,052	353	900	900	Official number
DK	106,074	53		~130	Ratio used 1:2.5
EE	8,745	4		~10	Ratio used 1:2.5
EL	113,647	57		~140	Ratio used 1:2.5
ES	703,727	352	2,000	2000	Official number
FI	57,446	29		~70	Ratio used 1:2.5
FR	1,030,212	515		~3,100	Use of the ratio for ES due to very high number of slaughterhouses
HU	156,334	78		~200	Ratio used 1:2.5
IE	85,184	43		~110	Ratio used 1:2.5
IT	564,132	282		~710	Ratio used 1:2.5
LT	41,884	21		~50	Ratio used 1:2.5
LU	0	0		0	Official number
LV	14,641	7		~20	Ratio used 1:2.5
MT	2,437	1		~5	Ratio used 1:2.5
NL	453,797	227		~570	Ratio used 1:2.5
PL	707,184	354		~2,100	Use of the ratio for ES due to large number of slaughterhouses and smaller size
PT	197,216	99		~590	Use of the ratio for ES; structure assumed similar

MS	'000s of birds slaughtered p.a.	Theoretical number of hangers required	Official number	Final figure /estimate	Comments
RO	182,488	91	3,500	3,500	Official number
SE	82,624	41	100	100	Official number
SI	31,843	16		~40	Ratio used 1:2.5
SK	49,813	25		~60	Ratio used 1:2.5
UK	930,423	465	1,000	1,000	Official number
EU-27	6,785,836	3,393		<b>~16,000</b>	

Note: final figure estimate (column 5) is equal to the theoretical number of hangers (column 3) multiplied by the ratio (column 6). Please refer to text above the table for a full explanation.

Source: Agra CEAS estimations based on Eurostat, national data sources, case studies, Competent Authority surveys and interviewees.

Findings in relation to the legal requirements for the training and qualification of staff, along with further findings on staff qualifications, are presented in Table 2.7 below. The table shows that there is some kind of requirement in legislation for training in 12 Member States of the 20 responding to our survey covering training requirements<sup>16</sup>. More precisely, of the 20 Member States:

- There is a clearly defined training requirement with accompanying qualification for people handling live animals in **eight** Member States (AT, CZ, DE, EE, IE, LV, PL, UK).
- There is requirement for suitable training stated in legislation, but this training is not clearly defined in **four** Member States (BE, DK, FR<sup>17</sup>, SK).
- There is no requirement in legislation at present in **eight** Member States (BG, ES, FI, HU, IT, NL, RO, SE). In Spain there are requirements in some regions; in Sweden training has been identified as being commonplace despite the absence of a legal requirement.

**Table 2.7: Legal requirements for qualifications of slaughterhouse staff in EU Member States**

MS	Requirements in legislation	Further details (where relevant)
AT	Yes	Slaughterhouse staff must demonstrate appropriate training in various areas. This can be demonstrated through: a) successful completion of university studies in veterinary medicine; b) passing the final exam in professional butchery; c) the successful completion of a suitable qualification from an agricultural college or an agricultural Educational establishment; d) the completion of any similar training in the necessary subjects which has been recognized as equivalent by the Federal Minister for Health; or, e) on the basis of a treaty in the context of European integration. See Annex I of legislation (BGBl. II Nr.488/2004) for full details.
BE	Yes	According to Belgian legislation, staff involved in slaughterhouse operations must have the knowledge necessary to perform slaughter in accordance with legislation. There is no legal reference to a specific course or qualification.
BG	No	

<sup>16</sup> This data was not collected for seven Member States as the Competent Authority did not complete the survey.

<sup>17</sup> This has changed following the creation of new legislation for implementing the certificate of competence requirement of Regulation (EC) No 1099/2009.



MS	Requirements in legislation	Further details (where relevant)
CZ	Yes	In order to carry out slaughter operations operatives must either: a) have achieved secondary vocational or have completed education in fields focused on the technology and processing of meat; or, b) have acquired complete secondary education in the field of veterinary prevention or higher vocational education in the field of veterinary medicine; or, c) be a university graduate who has implemented study schemes in the area of veterinary medicine and hygiene and in the area of agriculture focused on the veterinary area.
DE	Yes	Slaughterhouse staff must demonstrate appropriate training in various areas. To fulfil this requirement there is a certification procedure following a 1-1.5 day course which includes provisions on stunning and slaughter. Legally, only supervisors require this certificate, though in practice most staff hold one.
DK	Yes	According to legislation, slaughterhouse workers must have sufficient knowledge and necessary skills to perform the work in a humane and effective way. No specific qualification is identified in the legislation.
EE	Yes	(a) staff involved in slaughter must hold a certificate confirming theoretical and practical training. Theoretical and practical training covers animal anatomy, the physiology and behaviour of the species, plus practical skills in stunning, bleeding and slaughter. (b) All persons working in slaughterhouses completing operations other than stunning and bleeding must hold a certificate of completion of theoretical training on animal anatomy, physiology, and behaviour of the species involved and animal welfare requirements.
ES	Depends on region	There are official courses in some regions and private initiatives across the country. It is not possible to generalise at the national level. See section 7.2 of the case study for full details.
FI	No	
FR	Yes	Staff handling live animals must have completed general training on animal welfare. The responsible person in the slaughterhouse has the obligation to ensure that courses are available for staff, and that these courses are adapted to the slaughterhouse. The requirements for training have recently been updated in view of the forthcoming entry into force of Regulation (EC) No 1099/2009 <sup>18</sup> .
HU	No	
IE	Yes	Slaughter personnel must be licensed. Welfare officers must be formally trained. On-site training with specific relevance to the worker's job is required for all workers.
IT	No	
LV	Yes	A certificate of competence is required, specific details of which were not provided to Agra CEAS.
NL	No	
PL	Yes	People involved in slaughter must be at least 18, they must have completed basic education and they must have completed a theoretical course and three months working practice under the constant supervision of a member of staff with over three years

<sup>18</sup> See the link below for full details:

[http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=543630F79E59838E846403313F5608C1.tpdjo07v\\_3?cidTexte=JORFTEXT000026296323&dateTexte=20120917](http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=543630F79E59838E846403313F5608C1.tpdjo07v_3?cidTexte=JORFTEXT000026296323&dateTexte=20120917)

MS	Requirements in legislation	Further details (where relevant)
		experience.
RO	No	On the job training is provided locally at the discretion of the individual slaughterhouse. See section 6.2 of the case study for full details.
SE	No	While there is no formal requirement in law, workers involved in transport, bird catching and slaughter are almost always provided with training. There is no formal requirement in law for an animal welfare officer, but many slaughterhouses do indeed have one.
SK	Yes	There is a requirement that only people with the necessary knowledge and skills can engage in movement, lairaging, restraint, stunning and slaughter.
UK	Yes	A certificate of competence is required for slaughterhouse staff involved in slaughter operations; slaughter staff are assessed for competence by the official vet following on-the-job training. For other slaughterhouse staff there is no formal requirement, though it is estimated that over half of staff involved in unloading, lairaging and animal movement also hold the aforementioned certificate of competence.

Source: Agra CEAS own elaboration based on case studies and CA survey.

Combining the estimates of the number of staff involved in live handling (Table 2.6) and information on the training requirements for people handling live animals (Table 2.7), it is possible to derive estimates of the qualifications of staff in the EU handling live birds. These are presented in Table 2.8. It is important to bear in mind that an absence of formal training, with or without a qualification, does not mean that staff have not been trained “on the job”. There are sound economic reasons why staff would be provided with some form of training, although this may not extend to training specifically in respect of animal welfare, or may be minimal in this regard.

**Table 2.8: Estimates of the qualification level of staff handling live birds in the EU**

Category	Member States	Total number staff	% of all EU staff	Comments
<b>Qualified; formal training required and defined by law</b>	AT, CZ, DE, EE, IE, LV, PL, UK	~4,400	27%	In all cases, theoretical training is completed, though the scope and depth of this theoretical training varies. In most cases, practical or on the job experience is also required.
<b>Probably qualified; training required, but not defined by law</b>	BE, DK, FR, SK	~3,700	23%	Level of theoretical and practical training unknown, although it is likely that training takes place.
<b>Unclear; no formal training requirement in law</b>	BG, ES, FI, HU, IT, NL, RO, SE	~7,300	45%	Disproportionately weighted due to the large number of people handling birds during backyard killing in Romania. It is probable that there is at least some on-the-job training in most Member States.

<b>Unknown level of qualification</b>	CY, MT, LU, EL, LT, PT, SI	~850	5%	Member States in this category are generally small producers. Most of the staff are located in PT and EL.
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## 2.3. Use of different stunning methods

### 2.3.1. Description

Both our literature review and interviews have confirmed that there are, at the time of writing, only two commercially operational methods of poultry stunning in widespread use<sup>19</sup> in the EU: multiple-bird waterbath, and Controlled Atmosphere Stunning / Killing (CAS/CAK)<sup>20</sup>. There are other methods which are either under development, in a late testing phase or ready for commercial operation (but have not yet been purchased by a slaughterhouse), and these will be examined in greater detail in section 2.5.

It is important to note that, while CAS is considered one method of poultry stunning, there are significant differences between different CAS systems. Both equipment manufacturers and industry interviewees elaborated on this point. The main differences between CAS systems produced by different manufacturers<sup>21</sup> are as follows:

- **Design of the stunner.** The CAS stunner itself differs significantly. One manufacturer, Linco, uses a vertical deep pit system in which birds are lowered in their transport crates with CO<sub>2</sub> concentration increasing with depth. The other manufacturers, Marel Stork and Anglia Autoflow, use horizontal systems, although there are other significant differences, most notably the method of transporting the birds through the stunner (in transport drawers for Anglia Autoflow systems and on a conveyor belt for Marel Stork systems which requires the birds to be emptied from the transport crates).
- **Integration with the rest of the processing line.** Whereas waterbath stunners can generally be installed in isolation due to their relative uniformity, CAS stunners generally have to be installed as part of the larger pre-processing line. Most notably, the systems produced by each manufacturer interface with a specific method of bird transport available from the same manufacturer. It is not possible to connect transport systems and stunners from different manufacturers. The manufacturer Meyn has recently finished work on a new CAS stunner which overcomes this problem, but at the time of writing the stunner is not in commercial operation (see footnote 21).
- **Gas used and its delivery.** CAS systems can use inert gases such as argon and nitrogen which are anoxic, i.e. they deny oxygen to the bird, or CO<sub>2</sub> can be used which results in unconsciousness followed by death. Stunning systems using CO<sub>2</sub> can be monophasic or biphasic depending on

<sup>19</sup> Some small independent producers in France use a cheap manual head only stunner; however this is believed to only be used for a very small proportion of French production. See the French case study for more details.

<sup>20</sup> For simplicity we refer to CAS to include both CAS and CAK in the same way that waterbath stunning is referred to irrespective of whether the stun results in death.

<sup>21</sup> CAS systems in slaughterhouses in the EU at present have been manufactured by Marel Stork, Linco or Anglia Autoflow. Meyn has recently finished work on a new CAS system and the first commercial installation of this stunner in a slaughterhouse is scheduled for late October 2012.

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whether birds are rendered unconscious using lower CO<sub>2</sub> concentrations before concentrations are increased to induce death. Anglia Autoflow make both inert gas systems (due to previous legislative requirements in the UK), and biphasic CO<sub>2</sub> systems. Marel Stork and Linco systems use biphasic CO<sub>2</sub>, as will the new Meyn system. During the study it was confirmed that the majority of CAS systems use CO<sub>2</sub> (mono or biphasic) because this is substantially cheaper than argon and nitrogen. The only inert gas systems used in the EU are located in the UK for the historical legislative reasons explained above. It is considered likely that these systems will be gradually converted to or replaced by CO<sub>2</sub> systems following the decision to legalise this system in the UK from April 2012.

### **2.3.2. Throughput by system**

Electrical waterbath stunning is the most common method used for stunning poultry in commercial systems around the world (Prinz, 2011; Shields, *et al*, 2010), and also, according to interviewed equipment manufacturers, in the EU.

The tables below show estimates<sup>22</sup> regarding the proportion of birds stunned with each method in the EU where available, and what this means in terms of number of birds. It should be noted that in many Member States, the term broiler and poultry are used interchangeably due to the fact the vast majority of poultry production is broiler. In terms of data, this means that some of the estimates for broilers are in fact estimate for the wider poultry industry. Figures for turkeys and turkey parent stock are combined as Member States either did not differentiate between the species, or provided similar throughput estimates for both species.

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<sup>22</sup> For certain Member States, Agra CEAS obtained various estimations of the proportion of birds being stunned in each system (as was presented in the interim report). These estimates have since been triangulated (in general terms attaching the greatest weight to industry figures) in order to present the one final figure which can be found in the tables.

**Table 2.9: Broilers: stunning by system**

MS	Waterbath		CAS	
	'000s of birds	Proportion of total	'000s of birds	Proportion of total
FR	705,850	95%	37,150	5%
DE	243,606	40%	365,410	60%
IT	310,520	70%	133,080	30%
NL	344,217	78%	97,087	22%
PL	653,740	100%	-	0%
RO	179,881	100% (74.6%)*	-	0%
ES	573,648	97%	17,742	3%
SE	51,586	65%	27,777	35%
UK	546,388	64%	307,343	36%
<b>CS MS**</b>	<b>3,609,437</b>		<b>985,589</b>	
AT	24,440	35%	45,389	65%
BE	122,663	75%	40,888	25%
FI	5,261	10%	47,348	90%
Other***	928,815	100%		0%
<b>EU 27</b>	<b>4,690,616</b>	<b>81%</b>	<b>1,119,213</b>	<b>19%</b>

Sources: Agra CEAS own estimations based on Case Studies, manufacturer interviews and Competent Authority surveys  
 Number of broilers slaughtered either from national sources, or estimated for 2011 based on Eurostat and AVEC data.

\* In Romania, 25.4% of birds are killed on-farm manually.

\*\* CS MS = the sum of case study Member States (FR, DE, IT, NL, PL, RO, ES, SE, UK).

\*\*\* For all other Member States, it has been confirmed during the course of the study that only waterbath stunning is currently in operation for broilers, with the exception of CY, EL, MT and PT. In the opinion of Agra CEAS, it is very unlikely that any of these four Member States use CAS, and indeed the impact on the overall number of broilers stunned by system in the EU would be negligible due to the relatively small part of production that these Member States represent.

**Table 2.10: End of lay hens: stunning by system**

MS	Waterbath		CAS	
	'000s of birds	Proportion	'000s of birds	Proportion
FR	35,204	95%	1,853	5%
DE	24,582	100%	0	0%
IT	49,180	100%	0	0%
NL	12,480	100%	0	0%
PL	44,393	100%	0	0%
RO	4,656	100% (12.4%)*	0	0%
ES	44,000	100%	0	0%
SE	3,894	100%	0	0%
UK	6,760	26%	19,240	74%
<b>CS MS**</b>	<b>233,378</b>		<b>21,093</b>	
BE	2,341	50%	2,341	50%
DK***	0	0%	1,972	100% (70%)
Other****	55,798	100%		0%
<b>EU 27</b>	<b>283,289</b>	<b>83%</b>	<b>25,406</b>	<b>7%</b>

Sources: Agra CEAS own estimations based on Case Studies, Manufacturer interviews and Competent Authority surveys

Number of laying hens slaughtered either from national sources, or estimated based on the size of the laying flock from Eurostat or national sources.

\* 87.6% of end of lay hens in Romania (about 32.9 million birds) are slaughtered on farm.

\*\* CS MS = the sum of case study Member States (FR, DE, IT, NL, PL, RO, ES, SE, UK).

\*\* 30% of end of lay hens in Denmark are sent abroad. These are counted among the numbers of other Member States.

\*\*\* It has been confirmed during the course of the study that waterbath stunning is the only system currently in operation for laying hens in most other Member States. This was not categorically confirmed in AT, CY, EL, MT, PT, SI or SK, but in the opinion of Agra CEAS, it is highly unlikely that CAS is used for the stunning of laying hens in these Member States as the use of CAS has not been reported.

**Table 2.11: Parent stock: stunning by system**

MS	Waterbath		CAS	
	'000s of birds	Proportion	'000s of birds	Proportion
FR	10,400	100%	0	
DE	3,970	100%	0	
IT	2,892	100%	0	
NL	0	0%	12,480	100%
PL	4,261	100%		
RO*	0	0%	0	
ES	3,855	100%	0	
SE	427	100%	0	
UK	1,447	26%	4,118	74%
<b>CS MS**</b>	<b>27,252</b>	<b>61%</b>	<b>16,598</b>	<b>37%</b>
Other	0		0	
<b>EU 27</b>	<b>27,252</b>	<b>61%</b>	<b>16,598</b>	<b>37%</b>

Sources: Agra CEAS own estimations based on Case Studies, manufacturer interviews and Competent Authority surveys. Data on parent stock slaughtered were either provided during the case studies, or have been estimated based on the parent stock to broiler ratios of the UK and Sweden.

Parent stock are generally slaughtered in specialist facilities, the largest of which are in the Netherlands and France. As volumes are small, birds are often transported to these specialist facilities for slaughter. Given that the numbers of parent stock slaughtered in France and the Netherlands greatly exceeds the estimated annual turnover of the national parent stock flock (by roughly 100% in France and 500% in the Netherlands) it is assumed that these figures include birds from other Member States. This was indeed confirmed by some of the largest producers among non-case study Member States such as Belgium and Denmark.

\* 100% of parent stock in Romania; roughly 1.2m birds; are slaughtered manually on farm.

\*\* CS MS = the sum of case study Member States (FR, DE, IT, NL, PL, RO, ES, SE, UK).

**Table 2.12: Turkeys: stunning by system**

MS	Waterbath		CAS	
	'000s of birds	Proportion	'000s of birds	Proportion
FR	51,528	95%	2,712	5%
DE	22,705	60%	15,136	40%
IT	22,987	80%	5,747	20%
NL+	1	100%	0	
PL	22,518	100%	0	
RO	0	0%	5	100%
ES	9,761	60%	6,507	40%
SE	574	100%	0	
UK	845	5%	16,049	95%
<b>CS MS**</b>	<b>130,919</b>		<b>46,157</b>	
<i>Other*</i>	17,932	100%		0%
<b>EU 27</b>	<b>148,852</b>	<b>76%</b>	<b>46,157</b>	<b>24%</b>

Sources: Agra CEAS own estimations based on Case Studies, manufacturer interviews and Competent Authority surveys

Most recently available data from Eurostat used for the number of turkeys slaughtered.

+ Turkeys are not normally slaughtered in the Netherlands due to a lack of specialist facilities and the proximity of slaughter facilities in other Member States.

\* It has been confirmed during the course of the study that only waterbath stunning is currently in operation for turkeys, or that turkeys are not slaughtered in most other Member States. This was not categorically confirmed in AT, CY, LT, PT and SI, but in the opinion of Agra CEAS, it is unlikely that CAS is used for the stunning of turkeys in these Member States given that no CAS system for turkeys has been reported.

\*\* CS MS = the sum of case study Member States (FR, DE, IT, NL, PL, RO, ES, SE, UK).

## 2.4. National/regional measures

The stunning of poultry is currently regulated under Directive 93/119/EC. As of 1 January 2013, Regulation (EC) No 1099/09 will enter into force. The baseline (section 3.1) shows the new requirements with regard to stunning which the Regulation will introduce.

Under Article 18 of Directive 93/119/EC, Member States are allowed to introduce more stringent national/regional rules than those required under the Directive. Such national and regional measures which go beyond the requirements of the Directive are examined below.

### 2.4.1. Legal requirements for the parameters used for waterbath stunning

According to Directive 93/119/EC, *“The strength and duration of the current used in this case will be determined by the competent authority so as to ensure that the animal is immediately rendered unconscious and remains so until death”*. The legislative requirements in this regard are identified in Table 2.13 below. Some Member States have introduced additional duration and frequency requirements which are also presented in Table 2.13.

**Table 2.13: Requirement/guidelines for currents identified in Member States, as required by Directive 93/119/EC**

MS	Broiler		Turkey	
	Current	Duration/frequency	Current	Duration/frequency
AT	100mA	For 4 sec	150mA	For 4 sec
BE	None specified in legislation			
BG	120mA		150mA	
CZ	120mA	50hz for 4 sec	150mA	50hz for 4 sec
DE	120mA 160mA	for 4 sec for 10 sec without bleeding	150mA 250mA	for 4 sec for 10 sec without bleeding
DK	None specified in legislation			
EE	120mA	50hz (the combination is a recommendation)	150mA	50hz (the combination is a recommendation)
ES	None specified in legislation. CAs have non-binding recommendations outside the legislation which they cannot make public.			
FI	120mA	50hz (the combination is a recommendation only)	150mA	50hz (the combination is a recommendation only)
FR	None specified in legislation			
HU	Guideline only			
IE	None specified in legislation			
IT	None specified in legislation			
LV	240mA			
NL	100mA	Up to 400hz	-	
PL	120mA	For 4 secs	150mA	For 4 secs
RO	120mA	50hz (the combination is a recommendation only)	150mA	50hz (the combination is a recommendation only)
SE	120mA 150mA	up to 400hz; between 400 and 1500hz. No time requirement.	150mA 250mA	Up to 200hz Over 200hz No time requirement.
SK	160mA	For 10 secs		
UK	105mA		150mA	

Source: Competent Authority survey; case studies; HSA 2007; FiBL (2010).

#### **2.4.2. Requirements relating to the qualifications of people involved in slaughter operations**

Under Article 7 of the Directive, “*The competent authority shall ensure that persons employed for slaughtering possess the necessary skill, ability and professional knowledge*”. However, exact requirements for skills and knowledge are not specified in the Directive.

Some Member States have established specific requirements for the qualification of staff involved in the slaughtering process. These were outlined in Table 2.7 of section 2.2.4.



### 2.4.3. Other additional national and regional measures

In addition to the specification of minimum electrical stunning parameters and qualifications of staff, several Member States also have national measures in force relating to stunning which go beyond the requirements of Directive 93/119/EC. Such additional national measures which have been identified are presented in Table 2.14 below<sup>23</sup>; these generally relate to one of the following areas: gas stunning; religious slaughter; presence of animal welfare officer. As can be seen from the table, five Member States have measures which go beyond Directive 93/119/EC, with one Member State planning to implement Regulation (EC) No 1099/09 in advance of 1 January 2013.

**Table 2.14: National measures going beyond the provisions of Directive 93/119/EC**

MS	Additional measures	Early implementation	Nature of additional measures / comments
DE	X		Restriction on use of CAS; animal welfare officer required. See section 2.4.2 of the case study for full information.
FI	X		Religious slaughter; a specific Halal slaughter regulation.
LV	X		Stunning parameters; manufacturer's specified criteria should be used.
NL		X	Early implementation was scheduled for 1/9/2012. However, it has not been possible to confirm that the Regulation indeed entered into force as planned <sup>24</sup> .
SE	X		Restrictions on use of CAS; religious slaughter not permitted without stunning; rules on the withdrawal of food and water prior to slaughter; access to SOPs; 75db noise limit; backup plans.
UK	X		Restriction on use of CAS <sup>25</sup> ; animal welfare officer required. See section 9.4.2 of the case study for full information.

Source: Competent Authority and Avec surveys; case studies; FiBL (2010).

### 2.4.4. Stricter national measures following the introduction of Regulation (EC) No 1099/09

Following the entry into force of the Regulation, many of the restrictions mentioned in the table above will either be removed (e.g. restrictions on the use of CAS systems in Germany) or will no longer be additional to EU legislation (e.g. specification of electrical parameters; animal welfare officer requirements). Nonetheless, four Member States (Czech Republic, Germany<sup>26</sup>, Denmark and Latvia)

<sup>23</sup> These additional measures have been identified through a combination of the Competent Authority survey, a review of legislation, case studies and literature review. Given that not all Member States replied to the Competent Authority survey, it has not been possible to confirm the existence or absence of additional measures for all 27 EU Member States.

<sup>24</sup> Interviews with Dutch equipment manufacturers were carried out in October 2012. Some believed the implementation of the Regulation had been delayed at the last minute, while others reported that slaughterhouses were suffering quality issues under the parameters which entered into force on 1/9/2012. On balance it would appear that the planned early implementation has probably been delayed, but there is confusion in the industry given the last minute nature of the postponement. It should be noted that the early introduction of the Regulation had already been delayed twice. It is also important to note that, while the legislation in the Netherlands has been interpreted by many stakeholders as constituting a ban on the use of multiple bird waterbath stunners, the legislation is in fact simply a transposition of the Regulation and does not contain an explicit ban on these systems. However, due to the expected impact on meat quality of the electrical parameters in the Regulation, many stakeholders have interpreted the Dutch legislation as amounting to a *de facto* ban on waterbath systems.

<sup>25</sup> The restriction on the type of CAS system was removed from April, 2012.

<sup>26</sup> See the German case study for full details of the additional measures which are planned for Germany.

indicated in the Competent Authority survey that they were considering introducing measures in the future which are stricter than those laid out in Regulation (EC) No 1099/09. It was indicated during the case study that some of the provisions already in force in Sweden go beyond the requirements of Regulation (EC) No 1099/09 (noise limit, backup plans, access to SOPs and religious slaughter).

#### **2.4.5. Impacts of stricter national measures**

Because Directive 93/119/EC contains requirements for determining the strength and duration of stunning (although does not set the values), and for ensuring the necessary skill of slaughterhouse workers, the requirements set nationally cannot be considered to go beyond the EU legislation. However, it is clear that requirements do differ by Member State and that at present some of these are stricter than others.

There were indications (in particular from the slaughterhouse survey and case studies) that parameters currently defined in national legislation were having a negative economic impact through the effect on meat quality in some Member States. Indeed, in general, one may expect this to be the case with parameters defined in national legislation where these prevent practice which is commonly used elsewhere. There is also an extremely marginal negative environmental impact from using high currents due to the extra power requirement. On the other hand, the rationale for the definition of relatively strict parameters is to provide better animal welfare, and hence may also have positive social impacts. The entry into force of Regulation (EC) No 1099/09, which will introduce EU wide minimum parameters, should remove the differences in impacts stemming from different parameters at national level.

Comments on the impact of existing national level training requirements were limited, and no solid data were identified. Some interviewees did comment that official training courses may have positive social impacts through the effect on worker education levels. Though not directly stated by any interviewee, it is considered possible that there is a positive economic impact for slaughterhouses due to better staff performance and lower staff turnover rates. On the other hand, there will be some cost associated with training which will sometimes be borne by the slaughterhouse. On balance, national level training requirements were seen to have only a minor impact. Once again, the entry into force of Regulation (EC) No 1099/09 (introducing training requirements at the EU level) should minimise the differences in impacts between Member States in this respect.

**Table 2.15: Impacts of National measures going beyond the provisions of Directive 93/119/EC**

MS	Measures	Impacts
DE	Restriction on use of CAS; animal welfare officer.	More barriers to the installation of CAS systems, particularly for early adopters. Nonetheless, it should be noted that CAS uptake in DE is the highest in Europe.
FI	Religious slaughter	None identified.
LV	Use of manufacturer's specified criteria	None identified.
NL	Early implementation of Regulation (EC) No 1099/09	Difficult to judge given the uncertainty about implementation; however the industry has concerns with quality issues.
SE	Restrictions on use of CAS; no slaughter without stunning; food and water withdrawal requirements; access to SOPs; 75db noise limit; backup plans.	A minor economic impact of these additional measures. The parameters used for stunning in Sweden at present are considered to have a more substantial economic impact (see section 8.4.1 of the Case Study annex).
UK	Restriction on use of CAS; animal welfare officer	The non-acceptance of CO <sub>2</sub> for CAS which existed prior to April 2012 had negative economic impacts in terms of the operating costs of CAS systems because the gas mixtures which were permitted are more expensive.

Source: Agra CEAS own elaboration based on Case studies and interviewees.

## **2.5. Alternative stunning methods and improvements to existing stunning methods under development**

Several alternative methods for poultry stunning have been explored in recent years, though none of these are in commercial operation in the EU at the time of writing. These alternative methods address one or more of the areas of waterbath stunning which are considered to have negative impacts on animal welfare by EFSA, namely live shackling, inversion and the collective experience which results in an uneven stun. In addition to truly alternative systems, some research has taken place into modifications to the waterbath system in order to address these animal welfare problems. Methods and modifications which have been researched, or are in the process of being researched, are examined below. Two of these alternative methods, head only stunning and Low Atmosphere Pressure Stunning/Killing (LAPS) are analysed in the cost model in section 2.6 as these are considered to be closest to commercial use.

### **2.5.1. Head-only stunner**

Two different head-only stunning systems have been developed in the Netherlands. As will be explored below, both methods are considered close to commercialisation by the respective manufacturers, although other industry commentators expressed reservations. Information on these systems is based on interviewees with the stunner developers, with other equipment manufacturers and with stakeholders in the Netherlands, plus documentation provided by the developers.

#### **2.5.1.1. Background to the stunners**

The impetus for research into head-only stunners was a discussion on phasing out waterbath systems in the Netherlands<sup>27</sup> in 2008/09. One of the developers received financial support from the Dutch poultry industry, while the other started work independently, partly motivated by the desire to find a Halal compatible method which did not have the perceived quality issues implied by the currents in Regulation (EC) No 1099/09. It was suggested to us that a third manufacturer carried out research on a head-only stunning method (possibly with the support of the Dutch poultry industry), but this was discontinued.

#### **2.5.1.2. Current status of the stunners**

One of these head-only stunning systems is considered fully ready for commercialisation, having recently completed a successful two-month full operational testing period during which a Dutch state vet was present at all times in order to monitor performance<sup>28</sup>. The successful completion of the test period means the stunner has effectively been accepted as a method for stunning poultry in the Netherlands. The stunner remains in operational use in the slaughterhouse where it was tested. However, as the slaughterhouse in question has not purchased the stunner, the system should not yet be considered commercial.

The development of the other head-only stunner has been held up by the absence of the necessary authorisations for full testing; the positioning system had been fully tested at high speeds (up to around 13,000 birds per hour) by June 2012. Permission to test the positioning system in conjunction with the actual stunner was delayed, but has now been granted for a limited period of four hours per day, under the supervision of a Dutch vet, from 22 October 2012.

#### **2.5.1.3. Features and reliability**

Testing on both head-only stunning systems has been performed at speeds of up to 13,000 birds per hour, though most testing has been performed at lower line speeds between 7,000 and 9,000 birds per hour. According to the developers, the precise reliability of both systems depends on a number of factors (including the birds), but that reliability was above 98%, and in some cases as high as 99.1% for one system and 99.7% for the other system. It should, however, be stressed that no independent corroboration of performance is possible at this point in time.

Head-only stunning systems perform individual stunning (and hence avoid the EFSA-identified problem of the collective experience and uneven currents). In one of the head-only systems, the stunner detects the resistance of the bird required and calculates the current required for an effective stun milliseconds before delivering this current. Both systems include mechanisms for detecting whether or not a bird has been effectively stunned. However, inversion is an integral part of both of the systems and this animal welfare concern is therefore not addressed.

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<sup>27</sup> See Dutch case study for full details.

<sup>28</sup> Other testing of the stunner had also taken place during earlier stages of development.

The two systems have different approaches to shackling and the positioning of the head for the stun. In one of the systems, the bird is shackled by the legs (exactly as in waterbath stunning systems) and a scooping mechanism is used to detect the head and position it for the stun. The shackling has caused some problems with the scooping action for larger birds<sup>29</sup>, and options for modifying the shackling system are under examination. In the other system, the bird is placed upside-down in a cone, with the legs placed in the shackles (but without bearing the weight of the bird). Once the bird is stunned, the shackle lifts up, removing the bird from the cone and hence permitting further processing. This method is considered to avoid the problems of live shackling by the manufacturer, but again, no independent view on this has been provided.

Both systems require approximately the same amount of space as a waterbath system (though a different shape) and have been designed to fit into slaughter lines without major alteration. The manufacturers of both systems considered product quality to be a major benefit. One of the manufacturers emphasized the fact that the stunning method is clearly compatible with Halal and hence provides significant benefits vis-à-vis CAS systems in terms of market access. These aspects will be examined in more detail in the cost model (section 2.6).

#### **2.5.1.4. Outlook**

Given that there are two head-only stunners in the latter stages of development, it would appear probable that at least one will become available commercially. However, it should be noted that some industry interviewees expressed doubts about the potential for the systems to ever be fully commercialised. Most notably, one established equipment manufacturer explained that they had spent considerable time trying to bring such a system to market, but had been unable to do so effectively. The key problems they identified with bringing the head-only approach to market were reliability and robustness. Given that no head-only system has been used over a prolonged period and in a commercial setting, it is not possible to draw a conclusion in terms of whether a head-only system is likely to be sufficiently robust or not. It should also be noted that there have thus far been significant delays with both projects.

#### **2.5.2. Low Atmosphere Pressure Stunning/Killing (LAPS)**

A LAPS system has been developed in the US, and has been in commercial use in one slaughterhouse in the US for over a year; there has been no EU commercialisation to date, although an Italian equipment manufacturer is working towards this. Information on the LAPS system is based on various interviews, plus documentation from various sources including some provided by the EU representatives of the system.

##### **2.5.2.1. Background and current status of the stunner**

Development of the LAPS system took six years before a version was installed in a slaughterhouse in Arkansas (US) with a throughput of 21,600 birds per hour based on two processing lines operating at around 11,000 birds an hour. The system has been in commercial use since early 2011.

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<sup>29</sup> As their larger legs do not fit the shackles, hence the head is a bit higher in comparison to other birds from the flock.

The system received a “no-objection” status from the USDA in May 2010 and has also been accepted by the American Humane Association (March 2010) and fast food chain Wendy’s (May 2012). It is understood that the EU representative is in contact with the European Commission with regards to obtaining authorisation for the system in the EU.

#### **2.5.2.2. Features and reliability**

The system essentially works on the same principle as anoxic CAS systems, except no gas is required as atmosphere is removed rather than altered. More specifically, the system works as follows.

1. Standard transport modules are put onto a rail by forklift. These rails lead to the vacuum chambers.
2. There are four vacuum chambers. Two of the transport modules enter one of the vacuum chambers at a time (one module behind the other).
3. The chamber is sealed and air is slowly extracted from the chamber over a four minute period, causing a stun through gradual anoxia.
4. The stunned birds are then tipped out of the modules and shackled.

The four chambers are staggered in timing so that one chamber finishes the cycle every minute to allow for continuous post-stun shackling and the smooth operation of the processing line.

The current LAPS system operates at 11,000 birds per hour. Two interviewees thought that it would be possible to install the LAPS system in slaughterhouses with smaller throughputs by reducing the number of vacuum chambers or making the chambers smaller so that they hold only one transport module at a time; one interviewee said the system could be installed in slaughterhouses with a line speed of 6,000 birds per hour. That said, it was noted that scaling down through a reduction of the number of chambers could potentially have impacts on the steady flow of birds along the processing line and hence reduce overall efficiency.

The benefits of LAPS are considered by interviewees to be broadly similar to those of CAS. Meat quality is considered to be generally good, though there are problems with wing quality caused by flapping as can also be the case in CAS systems (see section 2.6.4). The working environment is considered to be comparable to CAS systems in that the atmosphere is less dusty and can be properly lit. The capital outlay is relatively high (broadly similar to that of CAS), but running costs are believed to be lower given that there is no requirement for gas. The system is effectively stun-to-kill, which means that it is unlikely to be considered compatible with religious slaughter. The costs and benefits of the system are considered in more detail in section 2.6.

#### **2.5.2.3. Outlook**

Although LAPS is already in commercial operation in one slaughterhouse in the US, no evidence has been supplied to suggest that the system has been, or will soon be, installed in any other slaughterhouses at the time of writing. Whether or not the system becomes commercially available in the EU will depend on whether it is accepted by the EU authorities. Academic papers considering the

animal welfare aspects of the system are being prepared at the time of writing in order to support the request for authorisation in the EU. It is, though, not possible to conclude whether the system would be accepted by the EU industry. There scalability of the system is at present unclear.

### **2.5.3. Head to cloaca stunner**

According to one interviewee, work on this method was discontinued due to meat quality issues caused by the current passing through the whole body of the bird. However, findings from LEI (2010) contradict this. The LEI study found that an effective stun could be provided under this system using settings of 70 mA and 70 Hz or 100 mA and 100 Hz applied for 1 second. Furthermore, the study reported that the breast fillet could be more tender and both breast and legs may contain fewer blood splashes than poultry stunned using the conventional waterbath method. However, according to HSA (2011), difficulties with placing such a device in a commercial setting include the guarantee of correct currents being provided to each bird, and the correct placement of the bird between the two electrodes (waterbath and cloaca). In summary, while research has been carried out on this stunning method, it appears unlikely that the method will be commercialised in its present form.

### **2.5.4. Containerised Gassing Unit**

The containerised gassing unit was developed in the UK as a method of killing poultry on-farm during a disease emergency. One interviewee believed that such a system could be adapted and used for small and medium-scale poultry processors, hence overcoming questions of economic viability of gas stunning for such producers. However, an equipment manufacturer explained that this system was not an option for birds entering the food chain because of the difficulties of interfacing the gas chamber with a processing line to allow bleeding to take place in a timely manner. In summary, it would appear unlikely that this method will be commercialised for use in the food chain.

### **2.5.5. Magnets**

Some research has been undertaken into the use of magnets for stunning by scientists at LEI Wageningen. However, according to one of the scientists involved, the work was merely an experiment, and while this method showed potential, full development would take several years. There is therefore no prospect of commercialisation in the short to medium-term.

### **2.5.6. Upright electrical stunning**

Silsoe Research Institute in the UK has completed some work on controlling birds and finding the position of the head without inversion and shackling, and on electrical stunning in this upright position. Initial work was funded by Defra in 2005/06. According to Tinker, *et al* (2005), this approach showed promising results, but required further work before commercialisation would be feasible. Most notably, there was an issue with birds from different flocks reacting differently at different points in the stunning line. Little work has been completed on this system since, although Silsoe Systems are trying to revive the research and submitted a request to Defra in 2011 for further funding (Berry, 2011).



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In summary, this method is a long way from commercialisation. Furthermore, it was explained to Agra CEAS that the method provides a portable, low line speed, high welfare method of stunning which would limit its applicability to commercial slaughterhouses. However, laying hens are considered one possible target group for this stunning method given their brittle bones.

#### **2.5.7. Individual head-only waterbath stunner**

Work on this system has been completed by Silsoe systems in the UK. The system itself, along with the resulting meat quality, has been examined by Lines, *et al* (2011a, and 2011b). With this system, birds are shackled in the traditional manner and the head of the bird is dipped into a waterbath. The current used to stun the bird is not passed through the bird's body from waterbath to shackle, but instead from one side of the waterbath to the other and hence only through the head<sup>30</sup>. The use of the waterbath avoids the need to precisely locate the bird's head (a challenge for traditional head-only stunning systems). By focusing on the head only, the system aims to address the issue of an inadequate and unequal stun. According to one interviewee, legs account for 40% of the electrical resistance of birds, and so bypassing the legs significantly reduces the difference in resistance between birds.

Lines, *et al* (2011b) found that the quality of the stun provided under this system does not compromise the quality of the breast fillet. However, Lines, *et al* (2011a) identified the power requirements of such a system as a significant potential barrier to its commercial use. With regards to this power requirement, given similar issues had previously been encountered and overcome during the development of humane stunning systems for fish, the developers thought that a way to overcome this problem could be found with further work.

In summary, this method remains some distance from commercialisation. One interviewee believed the method may not be attractive enough for commercial development, but is also arguably too advanced to justify public research funding, jeopardising the potential for further research.

#### **2.5.8. Inclined cone and head only stunning**

Work on two stunning innovations, an inclined cone, and head only stunning for use with manually restrained birds, is being completed in the framework of a Defra project. According to one interviewee, the two innovations are being developed independently but work on making the two systems work together is ongoing. Both systems are intended for small slaughterhouses handling up to 3,000 birds in a morning (so about 700 birds per hour maximum). The project is scheduled to finish during 2013, and the outlook for these systems will be clearer at this time. It was estimated that following the project end, it would likely take between six months and one year for the systems to reach market if a manufacturer decides to take these forward.

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<sup>30</sup> It was explained to Agra CEAS that following testing of this head only approach, it was deemed necessary to pass a small current through the body of the bird as well in order to prevent convulsions. However, this current is not relevant for the effective stun itself (the waterbath current is the one which stuns).



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### 2.5.9. Improvements to multiple-bird waterbath systems

In addition to genuine alternatives to multiple-bird waterbath systems, research has been undertaken on improving the existing system. Equipment manufacturers explained that there had been a number of advances in waterbath technology in recent years. That said, no manufacturers declared that they were actively undertaking research into directly addressing the elements of waterbath systems were identified as causing animal welfare issues by EFSA. The potential for insufficient stun was considered by manufacturers to have already been addressed through the entry into force of Regulation (EC) No 1099/09, but the issues of live shackling and inversion were considered to be integral elements of the waterbath system. However, Silsoe Systems took a different view and has undertaken research into solutions to directly address, or at least mitigate, problems caused by live shackling and inversion and these are discussed in the sub-sections below.

#### 2.5.9.1. Breast support conveyor for inverted shackled poultry

The breast support conveyor was developed to tackle the animal welfare problems caused by inversion. Essentially the conveyor belt supports the breast of the birds so that although shackled, there is no weight on the legs and as a result, no associated difficulty in breathing<sup>31</sup>. According to Lines, *et al* (2011), the use of this breast support conveyor had positive animal welfare impacts which resulted in less struggling and reduced carcass damage. Only in the case where a shackling line has sharp bends (90 degrees or greater) was it found that the conveyor had negative impacts on animal welfare.

The breast conveyor system is in use in two turkey plants in the UK, one of which has a throughput of 850 birds per hour. Although a number of issues have been identified, research is underway to address these as set out below:

- **Ergonomic problem for workers:** in order to shackle the birds already on the conveyor, workers must stand further back which can cause back problems. Work on a conveyor belt which bends from vertical to horizontal which moves the bird from hanging to being supported (and hence avoids this ergonomic problem) is ongoing.
- **Legs falling out of shackles:** without weight on the legs, and with a surface for the birds to push against, it is possible for the legs to disengage from the shackles. This problem has been addressed by placing a bar against the shackles so that legs cannot become disengaged. Although the concept works, the final design of the bar is still being refined.
- **Poorer quality from shackling lines with bends:** as commented above, sharp bends were found to have negative impacts on meat quality. This is considered to be due to the different speeds at which the breast and legs move, and the grinding effect of the bending conveyor on the breast. No solutions have been identified to this problem yet.

In summary, the fact that the support conveyor is in use in two commercial turkey plants suggests that it has commercial potential, although the line speeds in these plants is low.

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<sup>31</sup> It was explained by one interviewee that the absence of a diaphragm in birds makes it difficult for them to breathe once inverted and hung.

#### **2.5.9.2. Compliant shackles**

According to Lines, *et al* (2012), compliant shackles are shackles with springs which adjust to the size of the birds' legs, hence avoiding compression while still maintaining good electrical contact. In doing this they are considered to address the potential animal welfare problems caused by shackling. A small number of the shackles have been installed and tested in a small commercial poultry plant with positive results. The next stage is to install a large number of the shackles in a larger, faster processing line. The trial has only been underway for a few months, so it is not possible to judge the robustness of these shackles (normal shackles would last 4-5 years).

#### **2.5.10. Conclusions**

Among the alternative methods examined, head-only stunning and LAPS are the only ones which appear to be close to commercialisation in the EU. Other alternative methods should be considered speculative at this stage. Some of the research on improving the waterbath system shows promise, most notably the breast conveyor, which is in operation in a commercial plant. However, there remain challenges to overcome.

### **2.6. Costs of different stunning methods**

#### **2.6.1. Introduction and issues**

This section focuses on the cost of different existing stunning systems. More specifically, it compares the cost of waterbath stunning with CAS, and as far as is possible (given the limited commercial experience with the systems) also with head-only and LAPS systems.

In practice, it is very complicated to compare the cost of the different stunning systems for several reasons which are presented in Table 2.16 below under the "Issue" column. The approach used to overcome each problem is presented in the "Solution used" column. It is important to emphasize that while these solutions have been used to overcome the issues in creating a cost model, there is no perfect solution to overcome the problems, and the solutions proposed in the table do impact the robustness of the cost model. These impacts are presented in the "Implications" column.

**Table 2.16: Issues with creating a cost model, and methods used to overcome these issues**

Issue	Solution used	Implications
<b>Both installation and running costs will depend on the throughput of slaughterhouses.</b> Some stunning systems are considered inappropriate for certain sizes of slaughterhouse, and so data for lower levels of throughput are not readily available. There may also be <b>differences in costs by species.</b>	Data has first been collected for slaughterhouses with a capacity of 12,000 birds per hour <sup>32</sup> . We have then considered how this data would change if capacity were reduced to 6,000 birds per hour, and how it would further change if capacity is reduced to 3,000 birds per hour. Because of the mixture of fixed and variable costs the relationship is not linear. The cost model has been designed for broiler stunning.	Estimations are only available for the three levels of throughput described. Some of the estimations at certain throughput levels are theoretical because there are no commercial examples of some systems at some scales.
<b>Installation costs will vary on a case to case basis.</b> These can be impacted by the slaughterhouse building itself (in some cases major building reconfiguration will be required while in other only minimal changes will be needed). Existing installations and the manufacturer of the system being installed can also have an impact (fewer changes may be required if the new system is produced by the same manufacturer as the old system). There are too many possible configurations to generalise.	The cost model assumes the installation of the stunner only without any further alterations.	While the cost model will reflect costs where changes to the building are not necessary, this will be an under-estimation where changes are required.
While systems are broadly grouped together into the categories of “waterbath”, “CAS” and “head-only”, <b>there are differences between the systems produced by different manufacturers;</b> particularly in the case of CAS systems (see section 2.3.1). These differences can impact the costs, advantages and disadvantages of the system, and the magnitude of the alterations which are required at the time of installation.	Estimations provided by manufacturers have been aggregated and averaged in order to arrive at a single figure and respect manufacturer confidentiality. Credible data from other sources, most notably literature and our slaughterhouse survey, have also been included. The weighting of these data sources in the final cost figure is provided for each individual cost figure.	The cost of individual manufacturer systems is not available. Actual costs for an individual slaughterhouse may differ substantially from those presented in the cost model. The decision of an individual slaughterhouse as to which equipment manufacturer to purchase from may in fact depend on the equipment it presently has installed and/or the extent of alteration needed, plus any discounts it can negotiate.
<b>Confidentiality:</b> given the differences in design of stunning systems produced by different		

<sup>32</sup> In some cases, data for slaughterhouses with a capacity of 10,000 birds per hour is available; in such a situation, data on variable factors e.g. electricity usage are scaled up proportionally, while data on fixed factors are held constant.

Issue	Solution used	Implications
manufacturers, data on cost is in some cases commercially sensitive (most notably in the case of CAS systems).		
<b>The revenue</b> for poultry stunned with different systems varies considerably according to the end market. End markets can differ not only between Member States, but even within a Member State. It is therefore impossible to make generalisations about the revenue achievable from specific stunning systems <sup>33</sup> .	By definition, a cost model focuses on costs. Revenue factors will be analysed separately, largely in a qualitative manner under section 2.6.4. It is worth mentioning at this point that in many cases, the quality characteristics is a market access issue rather than a direct source of additional revenue.	Certain stunning methods are more expensive than others and a judgement based purely on costs will not explain why slaughterhouses nevertheless invest in these systems. However, these higher costs may be compensated for by higher revenues, although the extent to which (if any) this is possible will depend on the market sold into and will vary on a case by case basis.
<b>The amount of trimming</b> is not uniform per stunning system; it depends on various further factors including the end market and machinery used <sup>34</sup> .		
<b>The cost of inputs</b> may vary greatly across the EU. Most notably, the cost of labour is lower in southern and eastern Member States. The type of gas used will also affect cost; gas prices will also vary according to location, although data on gas prices are very scarce.	Data on cost parameters have been collected in preference to input costs to avoid these variations. Unit costs have then been calculated using EU average prices. The impact of different unit costs is then explored in order to provide an indication of how actual costs might vary. In terms of gas, it is assumed that CO <sub>2</sub> is used as this is the most cost effective; other, more expensive gases have only been used in practice where CO <sub>2</sub> has not been allowed, most of these plants are in the UK.	The costs provided will not be representative of the situation in a specific Member State. In order to understand the costs for an individual Member State, the cost model would need to be recalculated using unit prices for that Member State (which are not always readily available). Gas costs for systems using inert gases will be higher, although it is highly unlikely that new CAS systems will use gases other than CO <sub>2</sub> .
There is <b>limited commercial experience with LAPS and head-only systems</b> . The only source for data on costs for these systems is either the manufacturer itself, or studies commissioned by the manufacturer.	Available data sources at the time of writing are used and this includes a reliance on information provided by manufacturers.	Costs in a commercial setting may be different from the manufacturer estimates (most notably, maintenance costs may be significantly different). The estimate provided for these systems should be considered less accurate than those provided for other systems.

<sup>33</sup> The complexities are investigated in more detail in section 2.6.4

<sup>34</sup> As per previous footnote, the complexities are investigated in more detail in section 2.6.4.

## 2.6.2. Cost model elements and data sources

The parameters which influence the cost of stunning were discussed with various interviewees. Those included in the final cost model, together with a description and any necessary assumptions, are presented in Table 2.17 below.

**Table 2.17: Parameters included in the cost model**

Cost factor	Description
Installation cost	The cost of installing the stunner alone for a slaughterhouse. The assumption is that it is <b>not</b> necessary to replace the transport system.
Maintenance	Annual maintenance cost as a percentage of installation cost. The assumption here is that maintenance costs reflect complexity and are therefore correlated to price.
Labour for reception and hanging	Number of staff, hours per day required for the reception and hanging process.
Water for stunning	Litres of water required per day for stunning. This is not relevant to all systems.
Water for cleaning	Litres of water required per day for cleaning.
Electricity for stunning	Kilowatt hours of electricity per day.
Gas for stunning	Tonnes of gas required per day. It is assumed that CO <sub>2</sub> is used. Other gases will incur greater expense.
Other labour associated with stunning	Number of staff, hours per day required for labour in the stunning process beyond reception and hanging.

The parameters identified in the table are those which were universally agreed on by interviewees as having an impact on the cost of stunning. Some further parameters that may impact on the cost of stunning were identified by certain interviewees, although other interviewees believed that these parameters had negligible or no differential impact on costs. The impact on cost of some of these parameters was also connected to the manufacturer of the stunning system rather than the stunning system itself<sup>35</sup>. In view of this, these parameters have been omitted from the cost model. These omitted parameters include:

- transportation from the farm to slaughterhouse (including the capital cost of transportation modules);
- defeathering; and,
- maturation.

Issues involved in translating the parameters identified in Table 2.17 into a per bird stunning cost are discussed below:

<sup>35</sup> For example, a transport system from one manufacturer could have cost advantages over the transport system from another manufacturer. However given that the transport system of the manufacturer was designed to interface with stunning equipment from the same manufacturer, any cost benefits would depend on the combination of compatible transport and stunning systems. In this context, it should be remembered that not all four major EU equipment manufacturers are producing both waterbath and CAS systems at present.

- **Depreciation.** Various interviewees indicated that stunning systems have long lifespans (possibly over 25 years) and more often than not, slaughterhouses will repair existing stunning systems rather than install new ones. This was, to a certain extent, corroborated by our slaughterhouse survey where the average age of a stunning system was ten years and where there were examples of systems which had been in use for considerably longer. One manufacturer told us that slaughterhouses use a ten year depreciation period for investment purposes while another felt that a 5-8 year period was more normal. Based on the potential for longer life we have opted to use a depreciation period of ten years for the cost model.
- **Input costs.** As stated in Table 2.17, EU averages are used for unit input costs in calculating the basic stunning cost per bird. Maximum and minimum stunning costs per bird are then calculated using the range of input costs. Electricity cost is taken from the industrial cost of electricity from Eurostat for the second half of 2011; hourly labour costs are taken from Eurostat (and includes not only the wage, but also non-wage employer costs)<sup>36</sup>; water prices are based on recent EU estimations; and a price of €300 per tonne of CO<sub>2</sub> is assumed in line with the estimations of equipment manufacturers.
- **Labour use.** This factor has generally been omitted from other cost estimations for stunning systems. However, given the broad consensus that systems in which birds are shackled when already stunned or dead can result in an increase in labour efficiency (up to 25% according to some interviewees), the inclusion of this cost factor is important<sup>37</sup>. It should be noted that the inclusion of labour in the cost model calculation significantly increases the per bird cost of stunning, as it is the single most expensive component of the hanging process (e.g. 2.3 cents per bird assuming an average labour costs of €23.10 per hour and a shackling rate of 1,000 birds per hour). This explains the substantial difference between the cost figures calculated below and other estimates in the literature (for example, LEI, 2011), which tend to exclude labour costs and are therefore significantly lower.

The main data sources for the cost model are:

1. interviews with:
  - a. the four main EU equipment manufacturers: Anglia Autoflow, Linco, Marel Stork and Meyn;
  - b. the two developers of head-only stunning systems; and,
  - c. the EU representative of the LAPS system.
2. Data collected from the slaughterhouse survey. In the case of waterbath stunning, it was possible to separate out the cost data received by slaughterhouse size band while maintaining a reasonably

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<sup>36</sup> It should be noted that the employee cost used is the average of all jobs; one would expect slaughterhouse worker costs to be below this average. However, unfortunately data on slaughterhouse employment cost is not available; and the EU minimum wage is considered unsuitable for the calculation given data are only available on a monthly basis, and that the minimum wage excludes non-wage costs.

<sup>37</sup> Interviewees confirmed that shacklers can shackle roughly 1,000 live birds per hour. In systems in which the bird is already stunned or dead, this can reach up 1,250 birds per hour. With regard to alternative systems, one of the head-only stunning systems requires the positioning of the bird in a cone; it was explained that with training and practice, this operation can be completed at the same rate as the shackling of live birds, i.e. 1,000 birds per hour. Given the lack of long-term experience with this positioning operation, it has been assumed that the birds can indeed be positioned at a rate of 1,000 per hour. It is possible that, with more experience, it will become clear that the positioning rate is different from 1,000 birds per hour (and hence stunning cost is also different).



sized data sample. In the case of CAS, this separation of cost data by slaughterhouse size band was not possible due to the smaller data sample.

For waterbath and CAS systems, these two data sources have been given equal weightings of 45% in our cost model. Some estimations were also provided by other interviewees, or were found in literature and have been included in our calculations with a minority weighting of 10%. The reason for this is that while the literature and estimations used were considered broadly credible, there were nonetheless some doubts over the impartiality of some of the figures or issues with the completeness of the data.

While the two main data sources for waterbath stunning (manufacturer estimates and the slaughterhouse survey) were broadly similar, there were some substantial differences between data from the two sources in the case of CAS stunning. Most notably, gas usage estimated by manufacturers and gas usage reported by slaughterhouses differed considerably. This difference derives from the potential optimal performance (manufacturer estimates) and situation-dependant operational performance (slaughterhouse survey). There were also differences between the two sources, albeit less substantial, for maintenance and water usage.

For the head-only and LAPS stunning, the only data sources available are estimates by the system manufacturers and representatives. Given the differences between manufacturer and slaughterhouse figures identified for CAS, it is important to note that these figures are likely to be optimistic and that the performance of these systems vis-à-vis commercialised waterbath and CAS systems may not reflect commercial reality.

### **2.6.3. The cost of different stunning systems**

Estimations for the cost of stunning are presented in the tables below. Table 2.18 contains the basis calculations for the cost of different stunning systems in slaughterhouses with a capacity of 12,000 birds per hour. Average input costs are used in the first instance with figures also presented using high input costs and low input costs based on the range of data collected (labour, water and electricity).

**Table 2.18: Basis calculations for the cost of stunning with different methods for a throughput of 12,000 birds per hour**

<b>Cost factor</b>	<b>WB</b>	<b>CAS</b>	<b>Head only</b>	<b>Vacuum stunning</b>
Installation cost	€43,000	€308,300	€370,000	€500,000
Maintenance (% of installation cost)	3.45%	6.90%	3.00%	2.40%
Labour for reception and hanging	97 hours per day	90 hours per day	96 hours per day	90 hours per day*
Water for stunning and cleaning	9.0m3 per day	3.5m3 per day	0.96m3 per day	3.5m3 per day*
Electricity	5.2 kwh per day	127.0 kwh per day	9.6 kwh per day	1,136.0 kwh per day

Cost factor	WB	CAS	Head only	Vacuum stunning
Gas used	-	3.1 tonnes per day	-	-
Other labour	3 hours per day	5 hours per day	0.5 hours per day	5 hours per day*
<b>Cost per bird (EU Average)</b>	<b>2.439 cents</b>	<b>3.495 cents</b>	<b>2.521 cents</b>	<b>2.641 cents</b>
Cost per bird (high labour, water, electricity prices)	4.135 cents	5.105 cents	4.151 cents	4.367 cents
Cost per bird (low labour, water, electricity prices)	0.389 cents	1.562 cents	0.549 cents	0.679 cents
<i>Sources and weightings</i>	<i>Manufacturers: 45%; Slaughterhouse survey for capacity 9,000-13,000 (figures adjusted to capacity of 12,000) 45%; Literature: 10%</i>	<i>Manufacturers: 45%; Slaughterhouse survey for all capacities (figures adjusted to capacity of 12,000) 45%; Literature: 10%</i>	<i>Manufacturers</i>	<i>Manufacturers; labour estimates for CAS.</i>

\* Figures taken from CAS estimates given the similarity of the systems and the lack of specific data. Documentation clarified that no water is used in the LAPS stunning process, although water is used in CAS systems for cleaning.

Table 2.19 illustrates how the cost per bird differs at lower throughputs.

**Table 2.19: Cost model for slaughterhouses with capacities of 6,000 and 3,000 birds per hour**

Cost factor	WB	CAS	Head only	Vacuum stunning
<b>Differences at 6,000 birds per hour</b>				
	Installation cost slightly lower; water and labour usage lower; electricity usage approximately the same.	Installation cost, water and electricity usage the same. Labour and gas usage proportionally lower. Maintenance lower due to lower throughput.	Installation cost slightly lower (€350k), labour and electricity cost reduced proportionally.	Installation costs halved through removal of half the vacuum chambers (250k), electricity and labour also reduced proportionally.
<b>Cost per bird (EU Average)</b>	<b>2.541 cents</b>	<b>3.687 cents</b>	<b>2.716 cents</b>	<b>2.667 cents</b>
Cost per bird (high labour, water, electricity prices)	4.294 cents	5.330 cents	4.356 cents	4.412 cents
Cost per bird (low labour, water, electricity prices)	0.422 cents	1.730 cents	0.733 cents	0.682 cents
<b>Differences at 3,000 birds per hour</b>				
	Installation cost	Installation costs,	Installation cost	Installation,



<b>Cost factor</b>	<b>WB</b>	<b>CAS</b>	<b>Head only</b>	<b>Vacuum stunning</b>
	slightly lower, water and labour costs lower, electricity approximately the same.	water and electricity costs the same. Labour and gas costs proportionally lower. Maintenance lower.	as per 6,000 birds per hour (€350k), labour and electricity costs reduced proportionally.	electricity as for 6,000 birds per hour <sup>38</sup> . Labour reduced proportionally.
<b>Cost per bird (EU Average)</b>	<b>2.584 cents</b>	<b>4.053 cents</b>	<b>3.121 cents</b>	<b>3.087 cents</b>
Cost per bird (high labour, water, electricity prices)	4.340 cents	5.761 cents	4.780 cents	5.000 cents
Cost per bird (low labour, water, electricity prices)	0.463 cents	2.046 cents	1.116 cents	1.024 cents

Our cost model and analysis demonstrates that waterbath stunning is, on average, the cheapest stunning method and that CAS is the most expensive. LAPS and head-only stunning systems fall between these extremes (though in some cases, for medium-sized slaughterhouses, vacuum stunning is cheaper in theory, although there is no empirical evidence to corroborate this). However, it should be recalled that there is considerable reliance on manufacturer data for these systems which may be more optimistic than commercial practice.

<sup>38</sup> Installation costs are assumed the same as per 6,000 birds per hour as it is unclear if the system is scalable to a throughput lower than 6,000 birds per hour.

**Table 2.20: Breakdown of slaughter costs by element for the EU average cost scenario (cents and % of total cost)**

Cost factor	WB	CAS	Head only	Vacuum stunning
<b>12,000 birds per hour</b>				
Installation	0.018 cents (1%)	0.128 cents (4%)	0.154 cents (6%)	0.208 cents (8%)
Maintenance	0.006 cents (1%)	0.089 cents (3%)	0.042 cents (2%)	0.050 cents (2%)
Labour for reception and hanging	2.337 cents (96%)	2.157 cents (62%)	2.310 cents (92%)	2.157 cents (82%)
Water	0.010 cents (0%)	0.004 cents (0%)	0.001 cents (0%)	0.004 cents (0%)
Electricity	0.001 cents (0%)	0.012 cents (0%)	0.001 cents (0%)	0.111 cents (4%)
Gas		0.993 cents (28%)		
Other labour	0.067 cents (3%)	0.112 cents (3%)	0.012 cents (0%)	0.112 cents (4%)
<b>Cost per bird</b>	<b>2.439 cents</b>	<b>3.495 cents</b>	<b>2.521 cents</b>	<b>2.641 cents</b>
<b>6,000 birds per hour</b>				
Installation	0.032 cents (1%)	0.257 cents (7%)	0.292 cents (11%)	0.208 cents (181%)
Maintenance	0.013 cents (1%)	0.116 cents (3%)	0.088 cents (3%)	0.050 cents (2%)
Labour for reception and hanging	2.411 cents (95%)	2.157 cents (58%)	2.310 cents (85%)	2.157 cents (81%)
Water	0.008 cents (0%)	0.007 cents (0%)	0.002 cents (0%)	0.008 cents (0%)
Electricity	0.001 cents (0%)	0.025 cents (1%)	0.001 cents (0%)	0.111 cents (4%)
Gas		0.993 cents (27%)		
Other labour	0.076 cents (3%)	0.134 cents (4%)	0.024 cents (1%)	0.134 cents (5%)
<b>Cost per bird</b>	<b>2.541 cents</b>	<b>3.687 cents</b>	<b>2.716 cents</b>	<b>2.667 cents</b>
<b>3,000 birds per hour</b>				
Installation	0.061 cents (2%)	0.514 cents (13%)	0.583 cents (19%)	0.417 cents (13%)
Maintenance	0.024 cents (1%)	0.151 cents (4%)	0.175 cents (6%)	0.100 cents (3%)
Labour for reception and hanging	2.411 cents (93%)	2.157 cents (53%)	2.310 cents (74%)	2.157 cents (70%)
Water	0.010 cents (0%)	0.012 cents (0%)	0.004 cents (0%)	0.015 cents (1%)
Electricity	0.001 cents (0%)	0.050 cents (1%)	0.001 cents (0%)	0.221 cents (7%)
Gas		0.993 cents (24%)		
Other labour	0.076 cents (3%)	0.177 cents (4%)	0.048 cents (2%)	0.177 cents (6%)
<b>Cost per bird</b>	<b>2.584 cents</b>	<b>4.053 cents</b>	<b>3.121 cents</b>	<b>3.087 cents</b>

A key finding is that waterbath stunning shows a greater relative advantage over other methods where input costs are cheaper. However, in cases where input costs are higher, especially labour, the relative gap between the cost of waterbath stunning and other methods narrows<sup>39</sup>. This finding is coherent with

<sup>39</sup> The price of gas is clearly an important component and discussions with gas suppliers revealed that prices are highly variable depending on location and quantities required. While equipment manufacturers provided estimations of CO<sub>2</sub> cost around €300 to €350 per tonne, European Commission (2010) cited a starting figure of €100 in the Netherlands (although it is not clear whether this is delivered). Where slaughterhouses are able to access gas at this lower price the cost of CAS systems will decrease by up to 20% (12,000 birds an hour throughput) thus making CAS systems more competitive.

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the empirical observation that CAS is used in regions of the EU where labour costs are relatively high and not in areas where labour remains relatively cheap. Table 2.20 shows the contribution of different factors towards total stunning cost in different sizes of slaughterhouse for the EU average cost scenario.

In general terms, there is very limited literature with which the figures emerging from the cost model can be compared. PETA (2007) only estimates the cost of gas per bird, and not the cost of the whole stunning process. The only other recent document identified which compares costs is LEI (2011) which compares head-only and waterbath stunning. As already mentioned, the figures emerging from the cost model are somewhat higher than those emerging from the LEI study due to the inclusion of labour for hanging and other stunning operations in our cost calculation.

#### **2.6.4. Revenue aspects of different stunning systems**

According to the findings of section 2.6.3, waterbath stunning is the cheapest fully commercialised stunning method in the EU (and in the majority of cases, the cheapest of all methods, commercialised or non-commercialised). On cost alone, it would therefore be reasonable to expect slaughterhouses to choose waterbath stunning over CAS in all cases.

However, in some cases it may be possible for a slaughterhouse to obtain benefits in revenue terms from the use of a particular stunning system, and this may in turn impact the attractiveness of systems from an economic point of view. Revenue impacts are likely to occur through one or more of the following three mechanisms:

- **Market access.** A certain type of stunning system may be demanded by some distributors, either for reasons of quality, animal welfare, or in the case of halal/kosher, non-acceptance of certain stunning methods.
- **Higher revenue for better quality.** Higher revenue can result from a greater proportion of grade A product which commands a higher price and/or from a reduced need to trim fillets which results in greater uniformity. It is also possible that some markets will pay a further premium for meat which has other quality attributes such as a more consistent fillet colour.
- **Revenue losses through trimming and the cost of trimming.** As alluded to above, the extent to which portions need to be trimmed to meet market expectations will impact negatively on revenue both in terms of a reduction in yield and in terms of the costs of trimming (labour and/or capital in the case of automated systems)<sup>40</sup>.

As was outlined in Table 2.16, the ability to increase revenues will vary greatly both between Member States and between market niches within a single Member State, making quantification of these factors at an EU or even a Member State level unfeasible. It was emphasized to Agra CEAS by the vast majority of industry players, including equipment manufacturers, that the choice of stunning system is highly dependent on the market(s) that the slaughterhouse intends to sell to. Interviewees explained

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<sup>40</sup> It is, however, important to note that the amount of trimming will not only depend on the combination of end market and stunning system. It will also be impacted by the trimming equipment used (manual trimming is more precise than automated trimming, but incurs a higher labour cost), and whether a slaughterhouse trims meat itself or sells the meat untrimmed.

that the end market is likely to determine the stunning system selected and not *vice versa*; in other words, slaughterhouses will tend to choose the stunning system on the basis of the markets they are producing for rather than install a stunning system and then look for the best market for the resulting product. Furthermore, in many cases, one slaughterhouse will produce for more than one end market.

Various examples of the impact of end markets on quality requirements were provided by interviewees. For the whole bird, further processing and meat preparations markets blood spots and imperfections are less of a problem (given they are less apparent in the final product) compared to a retailer selling fresh cuts; the differences between systems in terms of trimming and downgrading selling to the former markets will be low. Within the fresh cut retail market, there will be significant differences with regard to the need to trim and downgrade. First, the nature of the cut will play an important role; blood spots are largely not an issue for legs or wings sold with skin (although broken bones may be), while blood spots clearly are an issue for deboned, skinless breast meat. It was explained that even among retailers in one Member State selling deboned breast meat there will be substantial differences in terms of quality and trimming demands. Discount retailers are less likely to demand uniformity in appearance (including size and fillet colour) and more likely to accept minor imperfections, meaning the level of trimming and downgrading will be lower compared to higher end retailers, who are likely to demand uniform products and hence are likely not only to demand more trimming, but also to downgrade a product rather than trim it.

In view of the complexities outlined above, it is not possible to generalise about revenue benefits. We therefore take a two-stage approach in order to assess potential revenue impacts. In the first stage, the impacts of different stunning systems on quality will be considered. In the second stage, the possible impacts of these quality issues on revenue will be examined for two scenarios at opposite ends of the market; the whole bird end market and the high end retailer breast fillet market.

#### **2.6.4.1. The impacts of different stunning methods on quality**

Comparing the impacts of different stunning methods on product quality, and hence the subsequent potential impacts on revenue, is a complicated task for various reasons, *inter alia*:

- No recent comprehensive study which directly compares the quality of meat from different stunning systems has been identified during the course of the present study. Interviewees warned that, given the significant recent changes in waterbath systems, older reports (e.g. from the 1990s) comparing quality or animal welfare aspects of CAS and waterbath systems should no longer be considered accurate.
- There are various recent sources of literature which examine the impacts on quality of specific systems. However, results from these different studies are not directly comparable, not only due to the different methods of presenting results used, but also the different methodologies used for completing these studies, including the stunning parameters used in the case of waterbaths. By way of example, LEI (2011), analysing the economics of the head-only system, found that only 16% of chicken breasts from waterbath systems were without blood spots; in contrast, a UK impact assessment for Regulation (EC) No 1099/09 found that some 83% of chicken breasts

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would not require major downgrading or trimming using the parameters close to those in the Regulation (Defra, 2012<sup>41</sup>). This very large difference in findings is partly attributed to the difference in stunning parameters used in the two studies (100mA/100hz in LEI (2011)<sup>42</sup> and 150mA/600hz in Defra (2012))<sup>43</sup>.

- It was emphasized by several interviewees that impacts on quality will vary greatly depending on a range of factors other than the stunning system. These factors include: the stunning parameters used (including the type of gas used in the case of CAS and the conductivity of the water in the case of waterbaths); the characteristics of the flock itself; the distance from farm to slaughterhouse; the timing of feed and water withdrawal; and, the manufacturer of the transport and stunning systems (given that there are significant differences between manufacturers in how birds are handled prior to slaughter and this can also impact on meat quality).
- There is extremely limited work on the quality aspects of the two systems which have not yet been commercialised in the EU (head-only and LAPS). Some data on the quality impacts of head-only stunning were presented in LEI (2011), although it should be stressed that these data are not based on commercial operation. One interviewee confirmed that, given the similarity of CAS and LAPS, the quality impacts of LAPS are likely to be similar to those of CAS (given the system works on the principle of anoxia, we consider it likely the quality is closer to that from an anoxic CAS system rather than that from a biphasic CO<sub>2</sub> system).

Notwithstanding the aforementioned complexities and caveats, information on the impacts of different stunning systems on product quality is presented below by type of product.

### **Breast**

The occurrence of blood spots on breast fillets is higher when using waterbath stunning than when using other methods. The exact level of blood spots depends on various factors, including the electrical parameters in use. In a limited scale non-commercial study, McKeegan (2007a) found 90% of CAS stunned breast fillets to be free of haemorrhages<sup>44</sup> compared to around 30% of waterbath stunned breast fillets. LEI (2011) found that 80% of breast fillets from head-only systems were entirely without blood splashes compared to 16% of fillets from waterbaths, though these figures should be considered with care given the parameters used for waterbath stunning and the fact that the figures are not based on large-scale operation. In contrast, Defra (2012) found that 83% of fillets from waterbath systems did not require major trimming or downgrading.

Breast fillets from CAS systems are lighter in colour and the colour is more consistent compared to those from waterbath systems. Apart from the preference of certain consumers towards meat of a certain colour, there may be implications for uniformity if breasts come from different systems.

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<sup>41</sup> Based on a 2006 study (Barker, 2006).

<sup>42</sup> It should be noted that no evidence was uncovered during the present study to suggest that such parameters would be widely used in a commercial slaughterhouse.

<sup>43</sup> Other methodological differences will also have an influence.

<sup>44</sup> In a later study in a commercial slaughterhouse (McKeegan 2007b), this fell to between 68% and 81% of fillets from CAS systems. However, waterbaths were not included in this case.

## **Legs**

Leg damage is generally higher in waterbath systems due to a combination of live shackling (which can lead to leg damage) and blood spots. In a limited scale non-commercial study, McKeegan (2007a) found 60% of legs from waterbath systems to be without bruises, compared with 90% of legs from CAS systems. LEI (2011) found that only 6% of legs from waterbath systems were without blood spots compared to 16% from head-only stunning. McKeegan (2007b) found between 67% and 70% of legs from CAS systems to be without haemorrhages. With regard to alternative systems, it can be assumed that live shackling is likely to result in a similar type and extent of leg damage as in waterbath systems.

## **Wings**

Wing damage is generally higher in CAS systems due to the flapping of wings during stunning. The exact level of damage depends on the gas used, but is more severe with anoxic gases. McKeegan (2007a) found that between 1% and 7% of wings from CAS systems were broken immediately after stunning compared to 0% of wings from waterbath systems. Barker (2006) found that 81% of wings from waterbath systems were without commercially significant red wing tip damage, and 75% of wings were without commercially significant haemorrhages.

## **Skin**

Several interviewees commented that defeathering may be more difficult in CAS systems, or the skin may be damaged if certain defeathering methods are used (e.g. soft scalding). McKeegan (2007a) found that between 37% and 67% of birds from CAS systems had three or more feathers left after plucking compared to just 20% from waterbath systems during a pilot study. Under commercial settings, the figure for CAS fell to between 15% 19%, but in this case there was no waterbath comparator (McKeegan 2007b). The impact of LAPS and head-only stunning systems on skin quality has not been analysed, however, given the nature of the systems it is likely that the quality of LAPS will be more similar to that of CAS stunning, and head-only to that of waterbath stunning.

The end market is therefore a major factor in any potential differences in revenue with the whole bird market not providing a major point of quality differentiation, although defeathering issues might be more apparent using CAS stunning. On the other hand, CAS systems can present higher quality breast fillet and leg portions while waterbath stunning results in higher quality wings. That said, it is important to reiterate that these trends are general and individual operators may be able to produce results which are not consistent with these.

The impact of potential revenue differences is discussed in the following sub-section.

### **2.6.4.2. Scenario analysis**

The potential impact on revenue in the whole bird and fresh breast fillet markets is considered in turn below.

### **The whole bird market**

Poultry sold in whole bird form is almost always sold with skin on which means that any haemorrhaging is not visible. On the other hand, broken bones may be visible, most notably if they also lead to a skin break and the presentation of the skin may bear some importance. No additional trimming will take place, and as a result no additional cost is incurred. Given that the bird is sold whole there is only one market to consider.

In view of the above it can be concluded that no stunning system offers any substantial revenue advantage over other systems in the whole bird market. It is possible, although the evidence is insufficient to be definitive, that in some cases waterbath stunning may have a slight revenue advantage over CAS systems due to the expected lower occurrence of visually identifiable broken wings and the more effective defeathering process.

### **The fresh breast fillet market**

High end retailers of breast fillets typically demand uniformity with no visible blood spots or fat. In some Member States, a preference for a certain colour of meat also exists. Evidence suggests that CAS systems offer some advantages here. As a result, slaughterhouses producing for this market will first need to achieve a certain quality of meat in order to gain market access<sup>45</sup>. Beyond this some trimming is likely to be necessary in order to meet retailer presentational requirements. In view of this, CAS systems will offer some revenue advantage over waterbath systems.

Estimating the size of this revenue advantage in quantitative terms is extremely difficult given the lack of literature on quality from different systems and the various other complexities that have already been set out. Nonetheless, Defra (2012), in conjunction with an EU average breast fillet price of €6.18 and average per bird breast fillet weight of 275 grams can be used to provide an indication of the potential magnitude of revenue differences<sup>46</sup>. From Defra, it can be concluded that using waterbath parameters close to those stipulated in Regulation (EC) No 1099/2009<sup>47</sup>, some 10.3% of broilers stunned in waterbath systems will suffer commercially significant damage to the breast meat, and on the basis of the data presented above, this damage will result in losses of between €0.11 and €0.51 for each bird affected<sup>48</sup>. On the basis of the data identified in section 2.6.4.1, it is assumed that there is negligible commercially significant damage to breast meat from CAS systems. From the data presented above, it can be concluded that the average revenue loss per bird due to downgrades and trimming from waterbath stunning is in the range of €0.011 to €0.052. This potential revenue difference for the higher end breast market can, in the best case, easily cover the difference in the cost of stunning with CAS, therefore making CAS systems competitive, and even potentially attractive in

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<sup>45</sup> Furthermore, it was indicated to Agra CEAS that some supermarkets in north western Member States have a preference for CAS systems resulting from a mix of animal welfare concerns and quality expectations. We have been told that in some cases these preferences will become requirements in the near future.

<sup>46</sup> The figures provided here are the same figures used in section 3.2.2.2, where the quality impacts of the regulation are calculated.

<sup>47</sup> Defra's findings are based on 150mA / 600hz AC, compared to the 150mA / 400hz stipulated in the Regulation

<sup>48</sup> The methodology used to calculate the revenue difference in this section is similar to the methodology used in section 3.2.2.2; in the low case it is assumed that just 10% of the breast is lost through trimming and this can be sold for 1/3 of the value; in the high case it is assumed that 30% of the breast is lost through trimming, and that the trim has no residual value.



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economic terms. It should be noted that the figure calculated above is based on trimming and downgrades, and that it is possible that an additional premium for market access is paid on top of this in some cases.

However, three further issues must be considered when considering the premium for the fresh breast fillet market:

- The ability of any slaughterhouse to obtain higher revenue in this segment is dependent on the slaughterhouse having access to the market. As mentioned above, the end market tends to determine the choice of stunning system and not *vice versa*.
- The potential for any kind of premium requires a difference in product quality and there is evidence to suggest that this is more likely to be achieved using a CAS system. The level of premium is a function of supply and demand. Whilst poultry produced in CAS systems forms a minority the premium will be higher. If the difference in quality diminishes (either because the technical performance of different systems changes or because the balance between systems changes) then the level of premium is likely to reduce and eventually disappear.
- Finally, slaughterhouses producing for the fresh breast fillet market will also need to find a market for the rest of the carcass, including cuts which are normally exported because there is little internal demand. If a CAS system is used, the range of Third Country markets to which these cuts can be sold will be reduced because the method is not universally accepted. In any situation where certain cuts cannot be sold, or where the price received is lower, the revenue received for the breast fillet will have to support the cost of production, slaughter and processing of other parts of the bird.

In summary, at one end of the scale, the whole bird market, there is little potential for differences in revenue received for poultry originating from different stunning systems. At the other end of the scale, the fresh breast fillet market, there is the potential to obtain additional revenue where CAS systems are used which is sufficient to compensate for the additional costs incurred using this system. However, the ability to benefit fully from this additional revenue is dependent on several other factors, *inter alia* access to these markets, access to a market for the rest of the carcass and the continued existence of the premium due to supply and demand balance.

Finally, it should be noted that there are significant differences between Member States in terms of the structure of end markets, and hence the potential for any additional revenue. For example, in the UK, the majority of poultry (60%) is sold deboned and consumption of breast meat is high, meaning there is greater potential to capture revenue benefits using CAS systems. In contrast, in Spain 44% of poultry is sold as whole bird with only 27% sold as breast meat and the balance consisting of cuts predominantly with skin or processed meat. There is therefore a lower potential to capture additional revenue from using CAS systems in this market.



## 2.6.5. Other differences between stunning methods

During the course of the study, some further differences between stunning methods have been identified. These financially unquantifiable differences are described below. The impact of these in economic, social and environmental terms is also specified.

### 2.6.5.1. Building and space requirements, and slaughterline reconfiguration

Various interviewees explained that there were differences between the space required by different stunning systems, with more space generally required for CAS systems compared to waterbath systems, and this could in turn have impacts on the building required. This implies additional **economic** costs where a waterbath system is replaced by a CAS system. The magnitude of this cost will vary on a case by case basis in line with the extent of building modifications required. However, a certain level of generalisation is possible. The space requirements for different stunning systems, along with their potential economic impacts vis-à-vis waterbath stunning, are set out in Table 2.21 below.

**Table 2.21: Space requirements and impacts on installation costs of different systems**

	Waterbath	CAS	Head only*	LAPS*
<b>Space requirements</b>	Long and thin; 4m x 1.2m approx for an 11,000 bird per hour waterbath.	Greater space required than for a waterbath; exact dimensions depend on manufacturer (deep pit and horizontal systems are fundamentally different).	Comparable to space required for a waterbath, but a different shape (circular; 3.2m diameter according to LEI, 2011).	No evidence from literature or interviewees; photographic evidence suggests it requires more space than a waterbath.
<b>Implications for new builds/house</b>	<i>Baseline</i>	Higher costs compared to waterbath, both in terms of land and structure itself. Differences considered significant by interviewees, but vary on a case by case basis.	Costs likely to be comparable to those of waterbaths.	No evidence from literature or interviewees; but if space requirements are higher than for waterbaths, issues are likely to be similar to those for installing CAS systems.
<b>Implications for upgrading existing s/house</b>	<i>Baseline</i>	Modifications to the slaughter line probably required. Building may need to be expanded, and this may also require additional planning permits. In some cases, there is insufficient physical space to expand the building or permits are unlikely to be granted. It is not possible to comment on costs as these will vary from	According to manufacturers, systems are designed to replace waterbath systems without major modification. However, the different shape may result in the need to reconfigure the	No evidence from literature or interviewees; but if space requirements are higher than for waterbaths, issues are likely to be similar to those for installing CAS systems.

		modest amounts upwards depending on circumstances. In some cases the costs will be prohibitive.	layout of the building and this may incur additional costs.	
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Source: Agra CEAS Consulting own elaboration.

\*Given that LAPS and head only methods have not been commercially installed in new build slaughterhouses in the EU, there is no evidence on the likely costs.

In summary, building and structural modification costs (which are not included in our cost model) are likely to be higher for CAS systems than for waterbath systems. However, although it is not possible to quantify these, the difference is likely to be significant in some cases and prohibitive in others. Despite the lack of evidence, it is considered likely that there would be additional costs if a waterbath system were replaced by a LAPS system. On the other hand, there are unlikely to be significant costs associated with replacing a waterbath system with a head-only stunning system.

#### 2.6.5.2. Working environment

Interviewees commented that stunning systems which avoided conscious bird-handling had positive impacts on the working environment (in addition to a positive impact on animal welfare which might also be judged a positive social impact). This has been corroborated by literature such as PETA (2007). The impacts can be considered to be both **economic** and **social** in nature:

- **More pleasant environment for workers:** lower dust levels (as birds do not flap their wings during hanging)<sup>49</sup>; lights can be fully turned on (as low-level lighting is not required to calm the birds); lower level of injuries as birds do not scratch and flap; wider pool of people who can perform the shacking operation (as strength is a lesser requirement).
- **Lower employee turnover:** according to PETA (2007), employee turnover can be between 75% and 96% lower. This can have unquantifiable economic benefits through reduced recruitment costs and potential improvements in efficiency, as well as potentially positive social impacts due to worker continuity.

In summary, the working environment is likely to be more pleasant in CAS and LAPS systems than in the waterbath and head-only systems, and this may in turn have positive economic impacts through lower employee turnover.

#### 2.6.5.3. Environmental impacts

RIVM (2009) compared waterbath and CAS systems against six environmental measures. The findings are presented in Table 2.22 below.

<sup>49</sup> In Germany, one slaughterhouse worker's union had formally complained about the dust levels in a slaughterhouse using waterbath stunning; and it was believed that as a consequence there may be legislative discussion regarding dust levels in the working environment.

**Table 2.22: Environmental impacts of waterbath and CAS systems**

Measure	Environmentally advantageous system	Comments
<b>Dust and odour pollution</b>	CAS	With waterbath systems, dust and odour problems occur primarily during unloading and prior to stunning due to wing flapping. With CAS they occur during unloading only (some systems do not require unloading) and within the stunning chamber, implying some advantage for CAS.
<b>Energy</b>	Waterbath	Energy for stunning in both systems is a small component of energy used by the whole plant (600kw). Waterbath systems use less energy compared to CAS systems (0.5kw – 1.5kw compared to 13-16kw).
<b>Unusable waste streams</b>	CAS	Blood and faeces are the main considerations. Some 0.2% of the live weight of the bird is lost in waste streams with waterbath stunning due to fractures and bleeding, and 0.06% with CO <sub>2</sub> gas stunning. This implies some advantage for CAS, at least using CO <sub>2</sub> .
<b>Water</b>	CAS	Some 0.25m <sup>3</sup> is used in the CAS stunning process according to RIVM compared to 1.5m <sup>3</sup> per hour for waterbaths. Some water is used for cleaning in both systems. Again, this implies some advantage for CAS systems.
<b>Cooling</b>	Neither	The stunning system may impact the maturation time and the required cooling capacity, which can affect both electricity and coolant uses (e.g. NH <sub>3</sub> ). In the Netherlands, neither system was considered to offer an advantage.
<b>Greenhouse gases</b>	Waterbath (CAS system dependant)	The greenhouse gas impact depends on the source of the CO <sub>2</sub> . CAS using CO <sub>2</sub> may contribute negatively to greenhouse gases if the CO <sub>2</sub> used is not a by-product of burning hydrocarbons or ammonia production in the context of other industrial production (considered the normal case in NL).

Source: Agra CEAS Consulting, based on RIVM (2009).

In summary, CAS can offer environmental advantages over waterbath systems in terms of dust/odour, waste and water, while waterbath systems offer environmental advantages over CAS systems in terms of electricity usage and greenhouse gas emissions. On balance, and in the context of the whole slaughter process, there would appear to be little difference in the environmental impacts of the different stunning systems, and ultimately the overall impact is really a political issue in terms of which environmental media are considered to be more important.

## **2.7. Comparison with Third Countries**

### **2.7.1. International trade in the poultry sector**

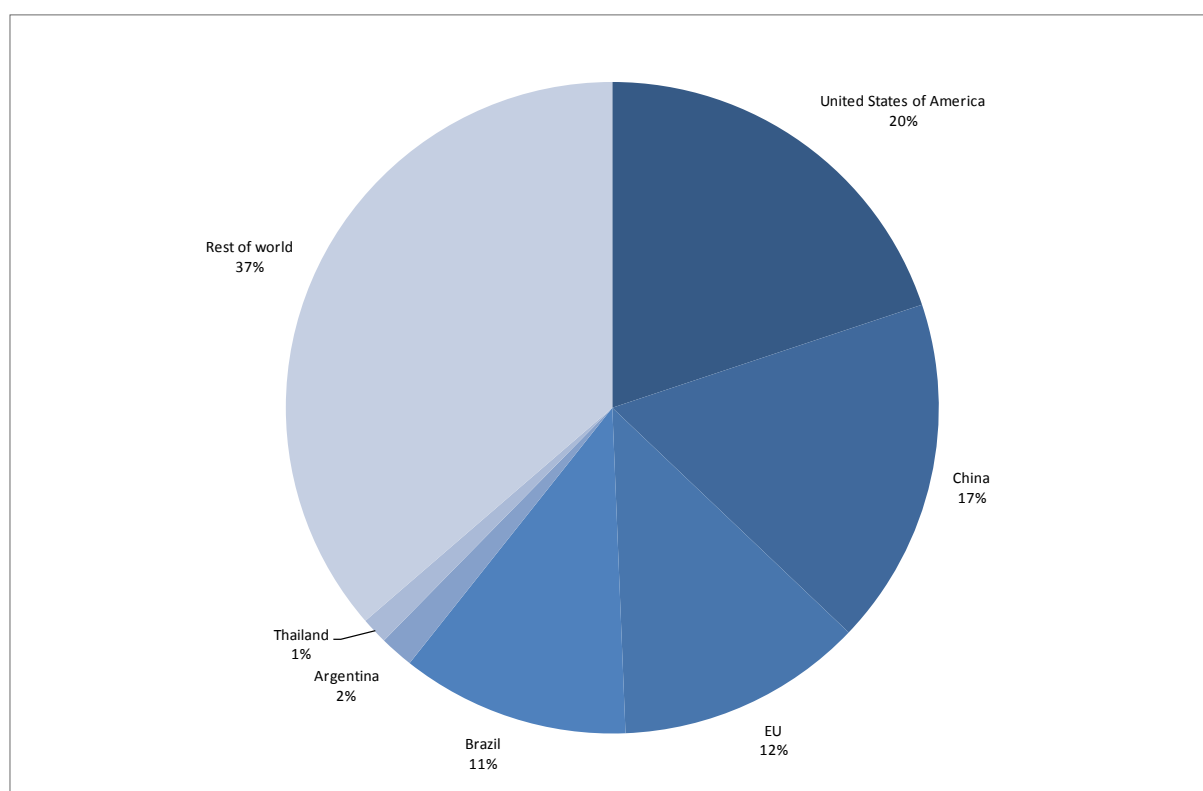
A large part of international poultry trade is in cuts for which there is no domestic demand. The preference in the EU (and the USA) is for white meat (breast) and hence dark meat (legs) are exported to Asian countries where the demand preference is reversed. The low production costs in exporting countries, whether from labour or feed, make this trade into the EU possible. Since the latest rounds

of accession the EU internal market resembles the global market to some extent with a consumer preference for white meat in the EU-15 balanced by a preference for dark meat in the new Member States. This has provided an internal outlet for dark meat surplus in the EU-15 and has allowed access to a relatively lucrative market for white meat for new Member State producers. This better market balance has reduced the EU's reliance on export markets to fulfil this function to some extent (Rabobank, 2011a).

### 2.7.2. Major global players in the poultry industry

According to FAOstat, some 98.5m tonnes of poultrymeat were produced globally in 2010. The single largest producer globally is USA, followed by China, then the EU and then Brazil.

**Figure 2.4: Share of global poultry production of major poultry producers and of trading nations with relevance for the EU (2010)**



Source: FAOstat

Table 2.23 shows that, in terms of trade, Brazil is the dominant player on the global poultry market for whole birds and white meat cuts and that it is second only to the EU in terms of trade in dark meat (because the EU consumer has a preference for white meat there is an exportable surplus of dark meat which can be sold at a competitive price). Brazil is less important in terms of processed meat where the low cost of labour in Thailand and China provides a competitive advantage. Argentina and the USA are also important global players with relevance to the EU.

**Table 2.23: Brazil's dominance in global trade, 2010**

	Ranking	Share of trade	Main markets	Main competitors
Whole birds	1	80%	Middle East	EU (supported by export subsidies)
White meat	1	85%	EU	Argentina (also Chile)
Dark meat	2	30%		US, EU
Processed meat	3	15%		Thailand, China

Source: Adapted from Rabobank (2011).

### 2.7.3. Slaughter systems used

As noted in Section 2.3.2, electrical waterbath stunning is the most common method used for stunning poultry in commercial systems around the world (Prinz, 2011; Shields, *et al*, 2010). The European equipment manufacturers are the only companies producing CAS systems globally. According to these manufacturers they have sold a small number of CAS systems in the following countries: USA, Canada, Australia, South Korea and Russia. However, the use of CAS systems on any appreciable scale is essentially confined to the EU.

### 2.7.4. Overview of key Third Countries

The main cost of poultry production is feed accounting for between 50% and 70% of total production costs (Rabobank, 2011a). Rabobank (2011a) states that Brazil, Argentina and the USA tend to benefit from 40% lower production costs than the EU and Asian countries as a result of cheaper feed (although currency movements obviously influence this). Rabobank (2011a) also notes that production costs in Thailand and India are slightly cheaper than in other Asian countries because of local grain production potential.

The sub-sections below present concise overviews of the poultry sector in these the key Third Countries.

#### 2.7.4.1. Brazil

An interview with the Brazilian embassy in Brussels revealed that the EU is considered to be an important export destination for Brazilian poultry and also that the EU and Brazil compete principally in the Russian and Saudi Arabian markets.

UBABEF (2010) reports that large poultry operators are vertically integrated with full control over feed and this also improves efficiency. The typical Brazilian model is for the large meat producing companies to provide rural producers with day-old chicks, feed, veterinary, sanitary and production management technical assistance. The farmers provide the production facilities, equipment and labour. The birds are delivered to the processors when ready. This approach allows new techniques, practices and standards to be introduced in a coordinated way along the production chain and ensures that the industry is very efficient.

Brazil's dominance of the global poultry sector has been achieved over the past decade as a result of a strong domestic market and an expanding export market (Rabobank, 2011a). The success in export markets is due to a competitive cost structure, largely the result of access to cheap feed and low energy requirements (25% lower than in the UK for example, Cranfield University, 2009<sup>50</sup>), but also due to economies of scale (a key point of difference with respect to Argentina) and an export focus whereby demand in export markets is met rather than exports being of cuts for which there is no domestic demand (this is in contrast to both the EU and the US where, with some exceptions, most exports are by-products of domestic demand).

Rabobank (2011a) expects Brazil to be the main beneficiary of increasing demand in export markets over the next decade due to its competitive advantages in terms of access to feed and ability to exploit economies of scale. The main threat to Brazilian exports is seen as being a strong currency and the potential for currency volatility.

#### **2.7.4.2. Argentina**

Rabobank (2011b) reports that access to cheap grain and protein makes Argentina a low cost producer. The Argentinean industry has developed rapidly since the economic crisis of 2001/02 and subsequent devaluation which left the sector internationally competitive (Avian Influenza in Asia provided a market opportunity which Argentina was able to exploit). The industry is now relatively concentrated with the largest two companies accounting for more than 40% of total slaughter and the top seven companies accounting for 78% of total slaughter. That said, these companies are small and medium-sized by international standards. There are more than 50 processors of varying scale. The industry is highly integrated with 95% of production carried out in this manner with the integrators providing day-old chicks, feed and professional advice and the growers labour and facilities. In 2010 there were around 4,500 broiler farmers, almost 90% of which were located in the provinces of Entre Rios and Buenos Aires, close to both domestic demand and grain production.

According to Rabobank (2011b), the Argentinean government provides an indirect subsidy to the poultry sector by imposing an export tax of 23% on maize and 32% on soybeans while the export tax on poultry products varies between 2.5% and 5%. Agrivalve (2011) puts the subsidy on soybeans at 35% and 32% for soy oil and meal, 20% for maize and 5% for poultry. The export tax on grains also means that domestic broiler producers can access feed at 23% and 32% below world market price. This position is further enhanced by a cap on export volumes which lowers the domestic price of feed materials still further. In practice the domestic price of feed materials can be 50% lower than the export price. Agrivalve (2011) states that the subsidies on feed represent 14%-16% of production costs.

Additionally, Rabobank (2011b) explains that production destined for the domestic market can receive compensation for the cost of maize and soybeans which is activated when the domestic market price

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<sup>50</sup> There are three main reasons for this. First is that a main feed, soya, has much lower transport burdens in Brazil, being relatively locally produced. Second is that Brazilian poultry houses are essentially naturally ventilated, but with limited fan use in very hot weather and that lower amounts of heating fuel are used for young birds. Third is that structures are simpler so that the housing burdens are smaller.

exceeds a reference price. For maize the reference price is AR\$ 293 (\$69) which compares to an average domestic price of \$136 in 2010. This policy was introduced in 2007 when agricultural prices were escalating and the government wanted to ensure that domestic retail prices did not increase. The agreement was that processors would not increase prices without government approval and in return compensation would be provided. Although payments are retrospective and can be up to a year late and the policy may be discontinued at any moment, the sector has received \$580 million since 2007 and this represents a substantial transfer of resources to the sector.

Taken together these policies partially shield Argentinean processors from high feed prices which provides a considerable advantage over other poultry producing countries. According to Agrivalue (2011), these policies have been regularly and heavily criticised by trade partners, but no serious attempt has yet been made to have them abolished.

Rabobank (2011b) notes that some 20% of Argentinean poultry production is exported and the country is the sixth largest global exporter selling into 58 markets, although the main destinations are Venezuela, Chile and China. Based on Argentina's favourable access to feed, its sanitary status and its capacity to increase production, Argentina appears well placed to meet growing demand in global markets and there is an expectation in the industry that exports could double in the next ten years serving the EU, the Middle East and Asia. According to Rabobank (2011b), export expansion may be further helped by preferential government loans (at 9% for five years compared to a market rate of 24%) under the Fondo del Bicentenario which is designed to help domestic industries grow and create employment; the poultry sector is the second largest recipient of funds after the car industry. Some \$72.3 million has already been approved for expanding plants and cold storage facilities and to incorporate technologies which should allow access to markets such as the EU.

#### **2.7.4.3. United States of America**

According to an interview with the US Poultry and Egg Export Council the US exports around 20% of total broiler production and 12% of total turkey production. Exports to the EU are very limited due to the use of antimicrobial treatments for campylobacter and salmonella and the main relevance to the EU is in terms of competition on export markets such as Russia which is an important (but declining) destination for surplus dark meat.

Approximately 90% of poultry in the US is stunned in waterbath systems and the remaining 10% in CAS systems. In addition there is one Low Pressure Atmosphere Killing plant in production in Arkansas. Animal welfare groups are actively seeking more widespread conversion to CAS systems, although there is no general consensus in the US that CAS systems offer animal welfare improvements over waterbath systems.

According to Rabobank (2011c), the US poultry industry is currently going through its second major downturn in three years and requires significant structural reform if it is to continue as a major global player in the poultry industry. A key problem is the orientation of the sector towards the production of white meat from large birds while the increase in the Hispanic and Asian population has resulted in an



increase in demand for dark meat. This has led to the ratio of price of boneless/skinless breast meat to leg meat falling from six to just above two. The focus on birds with large breast portions means that the US is not well placed to meet export demand for dark meat and is therefore at a competitive disadvantage on global markets.

The US poultry industry faces some challenges in terms of increasing costs and uncertainty imposed by the regulatory environment including increased regulations relating to immigration, free trade, animal welfare and water issues (Rabobank, 2011c). However, the biggest regulatory hurdles are:

- 1) Proposed new regulations from Grain Inspection Packers and Stockyards Administration of the USDA (GIPSA). These may alter the relationships and business practices, especially in relation to contract growers, although the USDA may agree not to go beyond the recommendations of Congress in the 2008 Farm Bill which would only entail small and manageable adaptations to practice.
- 2) Court rulings which have imposed fines on companies for cutting capacity which have inhibited the flexibility to adjust supply to demand.

Despite the problems set out above, the US has a surplus of maize and soybean and Rabobank (2011c) should be able to benefit from emerging demand for poultry in global markets if the industry is prepared to target these markets properly; the US currently has a minimal presence in the Middle East markets. That said, the US industry cannot afford new cost burdens at this time as major players in the industry have been losing substantial amounts of money recently. This makes it unlikely that the US industry will be able or willing to invest in new slaughter methods at this time.

#### **2.7.4.4. Thailand**

According to an interview with the Mission of Thailand to the European Union, the poultry sector is very important in Thailand both domestically and in terms of exports which account for 28% of production. Some 94% of current exports are of heat-processed product with the remainder exported as fresh meat. The most important export markets are Japan and the EU for processed product and Hong Kong, Bahrain and Malaysia for fresh product. Thailand's relevance to the EU is as an exporter of processed product; the EU and Thailand do not tend to compete on global markets.

Thailand suffered a major decrease in exports in 2004 following an Avian Influenza outbreak, but since then has benefited from the expansion of integrated producers, productivity improvements (including low feed conversion ratios), reduced processing costs, investment in production innovation and a shift to higher value cooked products (Agrivalue, 2011).

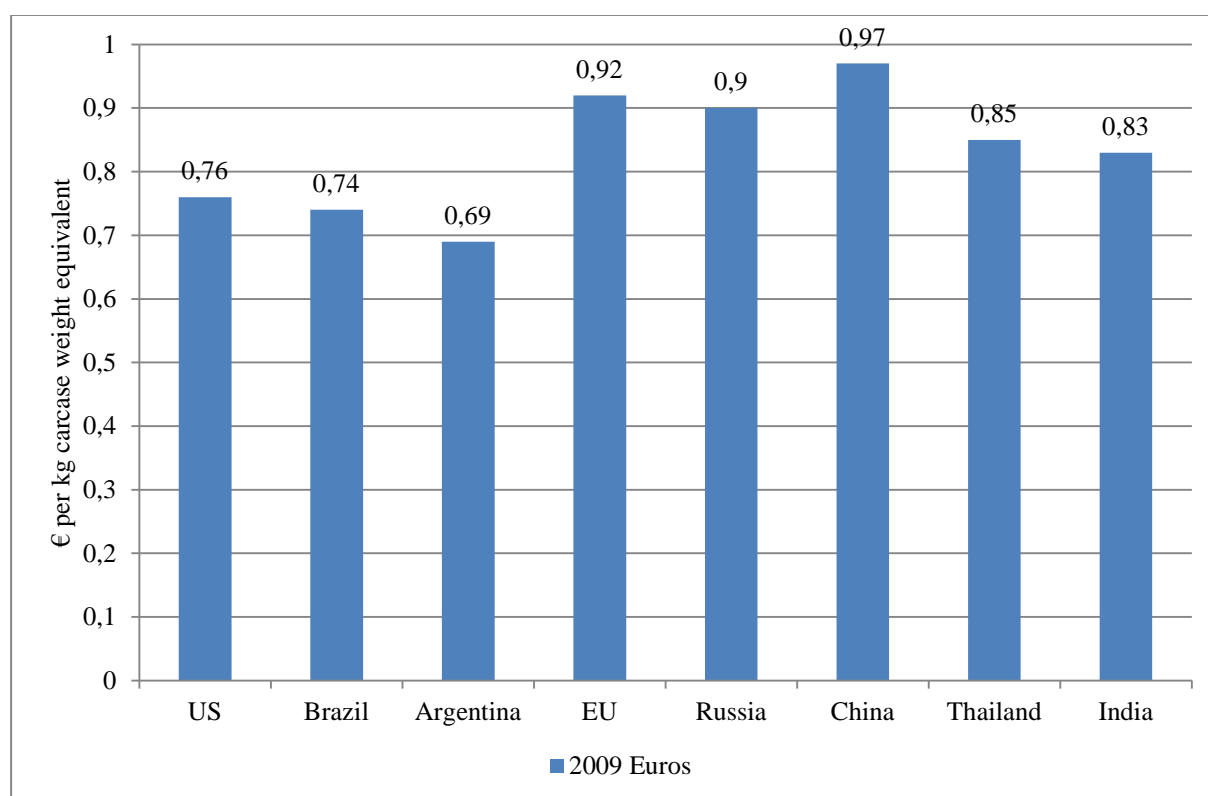
Thai national laws on poultry stunning are similar enough to those currently in place in the EU to be accepted as being substantially equivalent and the FVO reports show increasing confidence in Thai slaughterhouses. The Thai slaughter sector has been following developments in the EU for the past decade and should operate on a very similar basis to the large operations in the EU.



The Thai poultry sector is currently carrying out studies on stunning parameters as a background to discussing Regulation (EC) No 1099/09 with the EU. In doing this it has become apparent that the stunning parameters set out in Regulation (EC) No 1099/09 cause irreversible stunning which is not compatible with Halal slaughter and would constitute a problem in Thailand.

### 2.7.5. Third Country production costs

Figure 2.5 presents poultry production costs for selected countries in 2009 Euro terms. The lowest cost poultry producer was Argentina (although see above for the use of subsidies). Brazil was the second lowest cost producer and the US the third lowest cost producer. China had the highest costs, with the EU in second place, just ahead of Russia. Costs in Thailand and India were lower, but remained halfway between the low cost and high cost groups. Whilst the depreciation of the Euro in the current financial crisis will in theory have helped the competitive position of the EU, the impact of exchange rate movements on the price of feed and energy will have increased input costs.



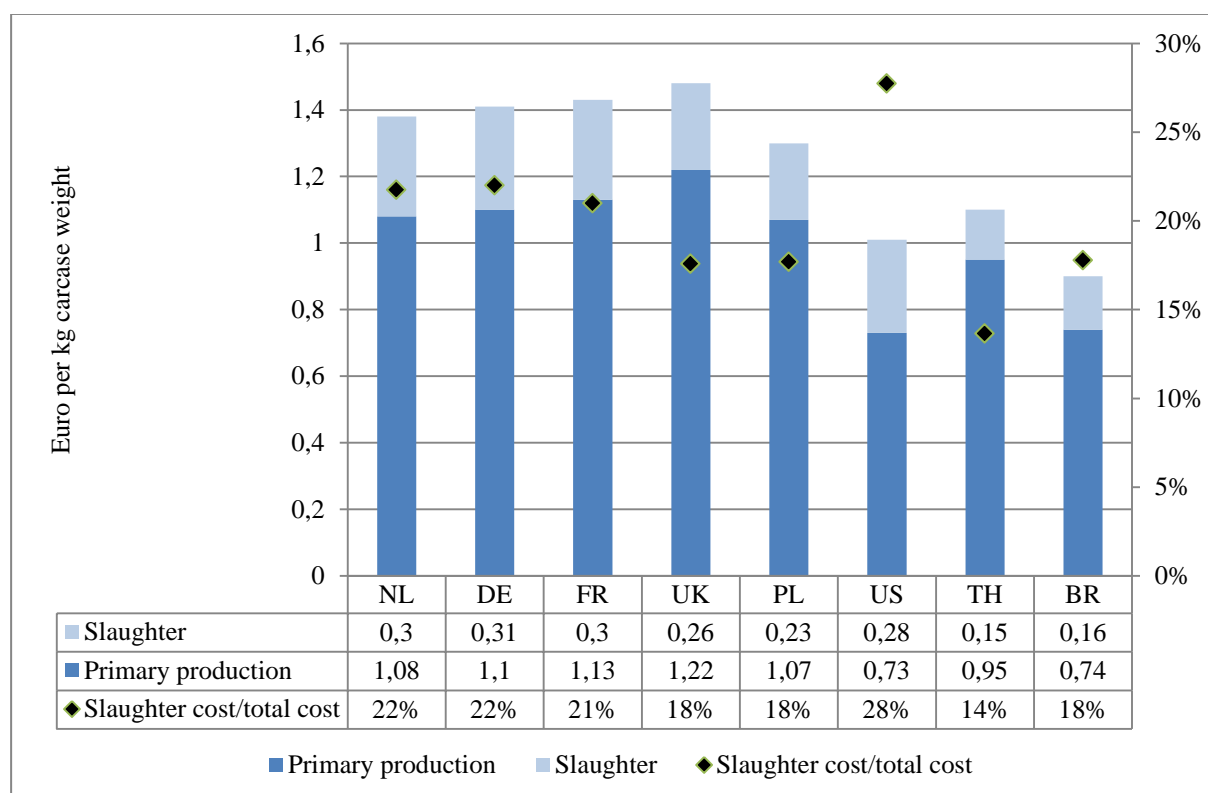
**Figure 2.5: Cost of broiler production, selected countries, 2009**

Source: Rabobank (2011a).

Van Horne (2009) carried out a similar international comparison of broiler meat production costs for the government in the Netherlands and concluded that US production costs were 32% lower than the average cost in the Netherlands, Brazilian costs were 33% lower and costs in Thailand 13% lower. The main cost element in poultry production is feed and lower feed prices in the US and Brazil, resulting from their proximity to large supplies of feed raw ingredients, largely explain the lower

production costs in these countries. Other significant cost advantages in Brazil and Thailand are the favourable climatic conditions and lower labour costs. Finally, van Horne cites a less costly legislative environment as a production costs advantage compared to the EU and specifically mentions the EU prohibition on the use of antimicrobial growth stimulators and meat and bonemeal as a feed ingredient.

Van Horne (2009) went on to add slaughter costs as presented in Figure 2.6. This comparison does not alter the relative position of any countries, but does show that slaughter costs add considerably to US production costs, but only minimally to costs in Thailand and Brazil. In absolute terms slaughter costs are around half as much in Thailand and Brazil as they are in the Netherlands, Germany and France, although the difference is less significant for the UK and, especially, Poland. Slaughter costs are largely determined by labour cost which is why there is an advantage in Thailand and Brazil.



**Figure 2.6: Primary production and slaughter costs for broiler production, 2009**

Source: Van Horne (2009) and Agra CEAS Consulting calculations.

### 2.7.6. Potential impact of higher EU slaughter costs

It is important to contextualise trade in poultry in order to understand any impact resulting from potentially higher costs. Global broiler meat trade doubled from 4.4 million tonnes in 1995 to 8.8 million tonnes in 2010 (Rabobank, 2011a). However, this is equivalent to only 13% of global supply and most production serves domestic markets. This is because of generally high import tariffs and a preference for fresh products which, in the case of poultry, means that production tends to take place

within 1,000 km of the final market. In the EU context this means that the important fresh market is largely protected from Third Country imports due to distance. However, there is a continuing increase in demand for further processed products and this market is vulnerable to lower cost Third Country competition.

Rabobank (2011a) expects 45% growth in world meat demand over the next 20 years (1.9% CAGR) and poultry should overtake pig meat as the globally preferred meat of choice due to efficient feed conversion rates and no religious restrictions on consumption. Against this background it appears unlikely that small increases in consumer prices resulting from differences in slaughter costs will lock the EU out of these growing export markets; differences in feed costs are likely to be the major determinant of competitive position.

International markets for poultry meat are demanding more processed products and efficiency as they develop from live broiler markets towards chicken-based ready meals (Rabobank, 2011a). This drive favours efficiency, quality and less labour intensive production systems. As applied to the slaughter stage of the process, these drivers should favour the increasing use of CAS over waterbath systems within the context of Regulation (EC) No 1099/09.

In conclusion, if CAS systems do result in increased consumer costs (and they may not do due to the potential for higher revenue), this is unlikely to result in an increase in lower priced fresh imports from Third Countries. This is also unlikely to be a key factor in reduced EU competitiveness on global export markets. On the other hand, increasing demand for further processed products may act as a driver in favour of CAS systems over the longer-term.

### **3. The policy baseline**

#### **3.1. The EU level baseline**

Regulation (EC) No 1099/09 will change or introduce several requirements which directly or indirectly relate to the stunning of poultry from January, 2013 and provides the background against which any future changes in policy must be assessed.

A comprehensive discussion of the main changes that the Regulation will introduce at the EU level is presented in Appendix 1: and this is summarised in Table 3.1 below. The changes presented in the table together with the dates of entry in to force of provisions form the baseline at the EU level.

**Table 3.1: Summary of the main changes outlined in Regulation (EC) No 1099/09**

Date	To present (October 2012)	1/1/2013	8/12/2015	8/12/2019
<b>Legislation/key changes</b>	Directive 93/119/EC in force	Entry into force of Regulation (EC) 1099/2009 <sup>51</sup>	Full entry into force of Article 21 <sup>52</sup>	Article 14 (1) applies to all slaughterhouses <sup>53</sup>
<b>Accepted methods</b>	<ul style="list-style-type: none"> <li>• Captive bolt.</li> <li>• Concussion.</li> <li>• Electronarcosis.</li> <li>• Exposure to CO<sub>2</sub>.</li> </ul>	<ul style="list-style-type: none"> <li>• Categories made more specific.</li> <li>• Introduction of inert gases, carbon monoxide and gas mixes.</li> </ul>	No change.	No change.
<b>Provisions for waterbath stunning</b>	<ul style="list-style-type: none"> <li>• Water level must ensure good contact with bird's head.</li> <li>• Strength and duration of the current are determined by the CA. For group stunning, the voltage must be sufficient to ensure every bird is stunned and remains so.</li> <li>• Appropriate measures must be taken to ensure the current passes properly, including good electrical contacts and wetting the shackle to leg contacts.</li> <li>• Baths must be an adequate size and depth for birds being slaughtered, and must not overflow at the entrance.</li> <li>• Electrode must extend the length of the waterbath.</li> <li>• Manual back up must be available if necessary.</li> </ul>	<ul style="list-style-type: none"> <li>• Specification of minimum currents.</li> <li>• Birds not shackled if this increases pain.</li> </ul> <p>For new slaughterhouses:</p> <ul style="list-style-type: none"> <li>• Device displaying and recording parameters.</li> <li>• The use of a system in contact with the breast.</li> <li>• Maximum hang time 1 minute.</li> <li>• Various other small changes and details regarding the installations.</li> </ul>	No change.	<p>For all slaughterhouses:</p> <ul style="list-style-type: none"> <li>• Device displaying and recording parameters.</li> <li>• The use of a system in contact with the breast.</li> <li>• Maximum hang time 1 minute.</li> <li>• Various other small changes and precisions regarding the installations.</li> </ul>
<b>Electrode/head-only stunning</b>	<ul style="list-style-type: none"> <li>• Must be placed so that they span the brain. Measures must be taken to ensure good electrical contact.</li> </ul> <p>For individual stunning, the apparatus must:</p> <ul style="list-style-type: none"> <li>• Incorporate a device which measures impedance of the load and prevents operation if minimum current requirement cannot be passed.</li> <li>• Incorporate an audible or visible device indicating the</li> </ul>	<ul style="list-style-type: none"> <li>• Specification of minimum currents.</li> </ul> <p>For new slaughterhouses:</p> <ul style="list-style-type: none"> <li>• constant current requirement, recording of parameters.</li> </ul>	No change.	<p>For all slaughterhouses:</p> <ul style="list-style-type: none"> <li>• constant current requirement, recording of parameters.</li> </ul>

<sup>51</sup> With some provisions to enter into force at a later date, as witnessed by the subsequent two columns.

<sup>52</sup> Prior to this date a simplified procedure is possible.

<sup>53</sup> Prior to this date the article applies only to new slaughterhouses.

Date	To present (October 2012)	1/1/2013	8/12/2015	8/12/2019
	length of time of its application to an animal. <ul style="list-style-type: none"> <li>• Display electrical parameters (visible for the operator).</li> </ul>			
<b>Gas stunning</b>	No specific provisions.	<ul style="list-style-type: none"> <li>• Entry of gas into chamber for CO<sub>2</sub>, inert gases and combinations.</li> <li>• General design rules for gas stunning systems in new slaughterhouses.</li> <li>• Measurement and record keeping rules for new slaughterhouses.</li> </ul>	No change.	<ul style="list-style-type: none"> <li>• General design rules for gas stunning systems in all slaughterhouses.</li> <li>• Measurement and record rules for all slaughterhouses.</li> </ul>
<b>Cross-cutting provisions</b>	<ul style="list-style-type: none"> <li>• Instruments, equipment and installations used for stunning and killing must be designed, constructed, maintained and used in such a way as to achieve the rapid and effective stunning or killing of animals in accordance with the Directive.</li> </ul>	<ul style="list-style-type: none"> <li>• Animals placed in equipment only when ready for all stunning methods<sup>54</sup>. Equipment must be maintained.</li> <li>• Information on slaughterhouse capacities available on request.</li> <li>• Some general design issues for new slaughterhouses.</li> <li>• A steady supply of animals for stunning must be available.</li> </ul>	No change.	Some general design issues for all slaughterhouses.
<b>Checks on stunning by slaughterhouses</b>	<ul style="list-style-type: none"> <li>• None foreseen.</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of self checking obligation based on a monitoring plan.</li> <li>• Introduction of an animal welfare officer.</li> </ul>	No change.	No change.
<b>Certification of staff</b>	<ul style="list-style-type: none"> <li>• No person can be involved unless they have the necessary knowledge and skills.</li> <li>• The Competent Authority shall ensure that the persons involved have the necessary skill, ability and knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of certificates of competence, though three years experience sufficient to obtain one.</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of full requirements for certificates of competence.</li> </ul>	No change.
<b>Other</b>		<ul style="list-style-type: none"> <li>• The introduction of the requirement for the manufacturer to provide instructions and recommendations, and of standard operating procedures.</li> </ul>	No change.	No change.

<sup>54</sup> This was previously only explicitly stated for captive bolt stunning.

### **3.1.1. Differences between Member States in the baseline**

#### **3.1.1.1. Legislative differences**

The previous section set out the baseline at the EU level. Section 2.4 examined national measures which go beyond Directive 93/119/EC. Four Member States (Czech Republic, Germany<sup>55</sup>, Denmark and Latvia) indicated that they **may** decide to introduce provisions which go beyond Regulation (EC) No 1099/09 (see section 2.4.4). However, details of these measures are not available at the time of writing. In Sweden there are some additional measures, the impact of which was considered minor.

### **3.1.2. Implementation of Regulation (EC) No 1099/09**

While no specific legislative differences between Member States have been identified after 1 January, 2013, there may still be differences between Member States due to differences in the interpretation and implementation of Regulation (EC) No 1099/09. However, a comprehensive analysis of the differences in implementation between Member States in implementation and interpretation is not possible given: (a) the Regulation is not yet in force; (b) only five of 17 Member State Competent Authorities who replied to the survey had fully drafted legislation for the implementation of the Regulation; and, (c) that either the drafted legislation was not publically available (DE) or it was not possible to obtain a full version (CZ, EE, LV, SE). Nonetheless, it is possible to comment on areas where the likelihood of differential interpretation is relatively high.

#### **3.1.2.1. Religious slaughter**

Under Directive 93/119/EC, stunning in accordance with the provisions of the Annex is not required in the case of religious slaughter. That said, some Member States either ban slaughter without stunning entirely (Sweden) or regulate religious slaughter (for example, Finland).

Regulation (EC) No 1099/09 contains a similar derogation from stunning requirements for religious slaughter to the one in the Directive. However, interviewees interpreted the derogation in the Regulation in different ways. Some considered that the derogation simply allowed for slaughter without prior stunning while others considered that the derogation allows slaughterhouses operating under the derogation to perform stunning for religious slaughter using parameters below those set out in the Regulation. These different interpretations will result in different outcomes as set out in the following section.

In addition to the interpretation of the derogation under Regulation (EC) No 1099/09, there is also the issue of its implementation; the procedure slaughterhouses must respect in order to operate under the derogation is not specified. The implementation of the derogation is therefore a decision for individual Member States. Member States have three broad options in terms of implementing the derogation for religious slaughter:

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<sup>55</sup> See the German case study for full details of the additional measures which are planned for Germany.

- **Authorisation:** slaughterhouses must submit an application to the Competent Authority which must be authorised before the slaughterhouse can operate under the derogation.
- **Pre-notification:** slaughterhouses must notify the Competent Authority before it starts to operate under the derogation. Following submission of the notification, the slaughterhouse can immediately start to operate under the derogation (without any reply from the Competent Authority). The Competent Authority has the right to examine the notification and prohibit the slaughterhouse in question from operating under the derogation if it so wishes.
- **Self control.** Slaughterhouses can choose themselves to operate under the derogation, with or without notification to the Competent Authority. The Competent Authority makes no decision regarding whether the slaughterhouse is entitled to operate under the derogation or not.

The combination of the interpretation of the religious slaughter derogation and the broad options for its implementation provide six different possibilities in terms of how the religious slaughter derogation might operate. There are two main issues with the six possibilities:

1. Given that the parameters in the Regulation are considered incompatible with religious slaughter, religious slaughter is likely to only occur under derogation (either with or without stunning). Interviewees indicated that religious slaughter without stunning can be more expensive than slaughter with stunning (which is in turn reflected by the price of the product) and hence a *de facto* ban on religious slaughter with stunning may have negative economic impacts.
2. If the parameters set out in the Regulation do lead to poorer meat quality (as evidence suggests – see section 3.2.2.2), and where Member States allow stunning using parameters outside those in the Regulation under the religious slaughter derogation, there will be an incentive for slaughterhouses to use the derogation even if the meat is not ultimately destined for a religious market.

The implementation of the derogation will therefore determine its impact as set out in Table 3.2 below.

**Table 3.2: Likely impacts of the combination of interpretation and implementation of the derogation**

Enforcement method / Interpretation of derogation	Authorisation	Pre-notification	Self control
No stunning only	<p><i>Scenario 1</i></p> <p>Potentially strong control from CA. Little incentive for operators to use the derogation unless their main market is religious due to additional costs. Halal sector likely to incur some additional costs.</p>	<p><i>Scenario 2</i></p> <p>Some control from CA. Little incentive for operators to use the derogation unless their main market is religious due to additional costs. Halal sector likely to incur some additional costs.</p>	<p><i>Scenario 3</i></p> <p>No control from CA, but also little incentive for operators to use the derogation unless their main market is religious due to additional costs. Halal sector likely to incur some additional costs.</p>

Enforcement method / Interpretation of derogation	Authorisation	Pre-notification	Self control
Stunning using parameters outside the Regulation	<p><i>Scenario 4</i></p> <p>Potentially strong control from CA. Incentive for operators to apply, but CA is in a position to ensure the system is not abused.</p>	<p><i>Scenario 5</i></p> <p>Some control from CA. Incentive of operators to notify and start operating under the derogation. It then falls upon the CA to stop any operator who is perceived to be abusing the system. Exact modalities of the notification process will determine the strength of such a pre-notification system.</p>	<p><i>Scenario 6</i></p> <p>No control from CA and hence a strong incentive for operators to stun using the parameters they wish (and thereby to circumvent entirely the provisions of the Regulation).</p>

Until the Regulation is fully implemented in all Member States, it is not possible to determine which scenario will apply in which Member State. That said, some evidence was collected during the course of the study on Member State implementation plans. One interviewee indicated that, at present, stun-to-immobilise parameters are used in the context of religious slaughter in under half of Member States, and that these tend to be from the EU-15 rather than from the 12 new Member States. Among the nine case study Member States, it would appear that three Member States intend to use combinations of interpretation and implementation which should completely exclude the widespread use of parameters below those set out in the Regulation. A further three Member States are likely to use interpretations which will permit the use of stunning parameters outside those specified in the Regulation, but with an authorisation system to prevent misuse. Finally, the intended interpretation and implementation is unclear and may provide the potential for misuse of the derogation in three Member States (Table 3.3). In summary, evidence suggests that, up to a third to a half of Member States may interpret and implement the religious derogation in a way which allows the possibility that poultry entering the non-religious market could be stunned using parameters outside those specified in the Regulation. This situation will become clearer following the entry into force of the Regulation.

**Table 3.3: Likely interpretation and implementation of the religious slaughter derogation in case study Member States**

MS	Likely scenario	Details / present situation
FR	4	Stunning with parameters outside those specified in the Regulation currently permitted, but only with CA authorisation.
DE	1, 2 or 3	Implementation unclear, but stunning with parameters outside those specified in the Regulation unlikely.
IT	4, 5 or 6	Stunning with parameters outside those specified in the Regulation will be permitted. A



MS	Likely scenario	Details / present situation
		notification system is used at present.
NL	1, 2 or 3	The government intends to only permit stunning with parameters in the Regulation, or to permit slaughter without stunning.
PL	4, 5 or 6	No authorisation system at present. Interpretation of Regulation likely to permit stunning with parameters outside those specified in the Regulation.
RO	4	Notification is required at present. The government intends to introduce a formal application procedure for religious slaughter under the Regulation.
ES	Unclear	Authorisation/notification for religious slaughter not required at present. Implementation of the derogation has not yet been considered.
SE	None	Slaughter without stunning is not permitted at present. The intention is that the religious slaughter derogation will not apply.
UK	4	Derogation interpreted as permitting religious slaughter with parameters outside those specified in the Regulation. The intention is to introduce an authorisation procedure for religious slaughter.

Source: Agra CEAS Consulting case studies.

### 3.1.2.2. Certificate of competence

Some concerns were expressed by interviewees with regard to the potential for different requirements between Member States for the certificate of competence (Articles 7 and 21 of Regulation (EC) No 1099/09). The concerns expressed were that requirements for the certificate of competence could be less stringent in some Member States than in others, and subsequently staff involved in live bird handling could have different levels of knowledge in different Member States, leading to a differences in welfare and also possibly in training and staff costs. Furthermore, it was mentioned by some interviewees that the requirement for mutual recognition could result in slaughterhouse staff receiving their certificate of competence in one Member State and then finding work in another where this certificate is considered inferior to that obtainable locally. According to some interviewees, this is already an issue under the present legislation. On the other hand, one interviewee commented that there is currently mutual recognition of certificates of competence for transport and that there are no apparent problems in terms of harmonisation.

The impact of differential implementation of the certificate of competence requirement will vary across Member States, although requirements for the full certificate of competence will not enter in to force until 8 December 2015. Any differential implementation may have some unquantifiable impact on animal welfare, but is likely to primarily have some economic impact on slaughterhouses in Member States where requirements are considered more stringent. There may additionally be issues of social equity where slaughterhouse colleagues could be differentially qualified, but working together equally.

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### 3.1.2.3. Measurement of parameters and methods of record keeping

Industry interviewees and manufacturers expressed some concerns about the potential for different methods of measurement of waterbath parameters and requirements for recordkeeping between Member States. More specifically, these concerns included:

- the methods used for checking waterbath parameters, including methods for measuring current;
- the precise parameters which must be recorded for waterbath stunning and the frequency of their recording (as required under Annex 2), and;
- the required level of accuracy of the recording device (as required under Annex 2)

Some interviewees believed that the interpretations of these factors could ultimately impact costs for operators. However, interviewees emphasized that with the lack of clarity in this area at present, it is not possible to speculate about the impacts. Several interviewees, including Competent Authorities, expressed the view that guidance from the Commission could help with this measurement and record keeping issue.

### 3.1.2.4. Private initiatives in existence in Member States

Although these are not part of the legislative baseline it is important to mention the existence of private initiatives which contain provisions relating to poultry stunning. While entirely voluntary, the existence of these provisions may already have influenced the stunning methods used by some slaughterhouses in Member States where they exist.

During the course of the study, it was indicated to Agra CEAS that some **multiple retailers and food service companies** have either requirements or preferences for specific poultry stunning methods (CAS) or requirements connected to particular aspects of the stunning process (e.g. the electrical parameters used for stunning). One food business operator (FBO) interviewee commented that there had been an increase in the volume of poultry it sourced from CAS systems in recent years, not due to any formal requirement, but due the independent conversion of its suppliers for economic reasons, specifically a higher yield of grade A meat. It should be noted that in general, requirements or preferences relating to stunning are found among FBOs in north western Member States (e.g. UK, NL), though one FBO which operates at a European level was identified as having pan-EU requirements for poultry stunning. These requirements are generally not made public. Various reasons were provided by interviewees for the existence of slaughter preferences and standards among some FBOs, though the key reasons were considered the protection of brand image, avoidance of pressure from NGOs, and specifically in the case of a preference/requirement for one stunning system, the quality emerging from the system in question.

**Private labelling schemes** which cover slaughter requirements have been identified in four Member States, with a scheme under development in a fifth Member State. These all happen to be case study Member States. A summary of these schemes are presented in Table 3.4 below. There was no indication that private labelling schemes covering slaughter requirements will emerge in other case study Member States (IT, ES, PL, RO) and schemes were not identified in other Member States.

**Table 3.4: Private labelling schemes which include poultry slaughter requirements**

Scheme name	MS	Slaughter Requirements	Comments
RSPCA / Freedom Foods	UK	A prohibition on the shackling of live conscious birds from 2016. Average minimum current of 120mA for broilers/150mA for turkeys and frequency of 50hz. Minimum hang time of 30 seconds. Various other requirements which indirectly relate to stunning, e.g. employee qualifications.	51.6 million broilers (6% of total) slaughtered to Freedom Food standards annually, 90% of which pass through CAS systems. Some 40,000 turkeys for the Christmas market are slaughtered to Freedom Food standards (40%).
Beter Leven	NL	Animal welfare in products is rated on a 3-point scale using stars. For poultry products, one of the requirements for the star rating system is the use of a CAS system.	No data on market share; however, considered likely to be considerable.
Svensk Fågel	SE	No requirement to use a particular stunning method. First 50 birds stunned must be checked to ensure that the stun is effective each time the slaughter line is started. Rules on wing damage, proportion of birds dead on arrival after transportation and red skin.	98% of poultry in Sweden is sold under this label.
Deutscher Tieschutzbund label	DE	Exact requirements not yet decided. Likely to contain requirements for stunning, exact nature of which are currently unknown. Unlikely to contain a requirement to use CAS given the importance of small slaughterhouses. At present there is an environmentally focused scheme, Neuland, which is supported by the Deutscher Tieschutzbund.	Work in progress; expected to be launched in 2013.
Label rouge	FR	A quality label; animal welfare is not the main driver behind the label. There is the requirement during slaughter for the maximum avoidance of stress and pain to animals; however, there are no specific requirements going beyond Directive 93/119/EC.	Market share of up to 30%.

Source: Agra CEAS Consulting based on our surveys, case studies, interviews and literature review.

### 3.1.3. Summary of the baseline

While there are substantive differences in the legislative baseline at present, from January, 2013, this will become more uniform at the EU level. However, it is possible that differences will emerge in the legislative position between Member States both through the introduction of legislation which goes beyond the Regulation and through different interpretations / implementations of the Regulation. Private initiatives will have some impacts in the five Member States listed in Table 3.4, but similar schemes are unlikely to emerge in other Member States.

## **3.2. Impacts of the baseline**

Given the expected relative uniformity of the legislative baseline after January, 2013, our analysis of the impact of the baseline will focus on the entry into force of Regulation (EC) No 1099/09.

### **3.2.1. Quantitative impact on animal welfare**

A qualitative analysis of the impacts of the baseline on animal welfare is outside the remit of this study. However, assuming that waterbath stunning using the parameters in Regulation (EC) No 1099/09 leads to improved animal welfare, it is possible to calculate the number of birds which will benefit under the baseline.

Section 2.3.2, calculated that some 5.15 billion birds<sup>56</sup> (roughly 81% of the total) pass through slaughterhouses with waterbath systems in the EU-27. Legal requirements or guidelines were identified in 13 Member States representing roughly 50% of EU-27 production (eight of these Member States provide requirements or guidelines for currents only, while five provide them for both current and frequency). HSA (2011) reports on a survey of some western European slaughterhouses with throughputs of over 6,000 birds per hour. Some 63% of surveyed slaughterhouses used AC with an average current of 96mA. The average current using DC was 74mA. The average frequency of all both waveforms was found to be 543hz. Our own slaughterhouse survey found that the average parameters used for broilers are 101mA and 370hz (74% AC, 22% DC and 2% both)<sup>57</sup>. One industry interviewee explained that slaughterhouses have begun to use lower frequencies during the last year while maintaining the same current, which suggests that the HSA findings and those of our survey are broadly coherent. It is therefore assumed that, at present, average parameters used for stunning in the EU are around 100mA and 400hz

EFSA (2012) presents EEG evidence on the effectiveness of stun using different parameters. Two-thirds (67%) of broilers stunned with an AC current between 1-100mA and 200-400hz are considered to be effectively stunned. These parameters are broadly in line with our conclusion on present industry practice above, which in turn is based on HSA (2011) and our survey evidence. According to EFSA (2012), 95% of broilers are effectively stunned when using an AC current between 101-150mA and 50-200hz; while these parameters are not directly in line with those outlined under Regulation (EC) No 1099/99, they provide a reasonable proxy for the Regulation. The findings of EFSA therefore imply that approximately 28% more broilers stunned in waterbath systems will be stunned effectively from January, 2013 (assuming full compliance). This translates to an additional 1.31 billion broilers receiving an effective stun, i.e. 23% of all broilers slaughtered annually in the EU.

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<sup>56</sup> The species within the remit of this study, namely broilers, laying hens, parent stock, turkeys and turkey parent stock.

<sup>57</sup> While the average parameters recorded in the slaughterhouse survey at EU level were below the existing requirements in some Member States (Table 2.13), the majority of responses (57%) from the slaughterhouse survey came from Member States without legal requirements (e.g. BE, FR, IT, ES, HU), hence permitting legal operation with currents lower than those mandated in some other Member States. Notably there were no responses to the survey from many Member States with high current requirements such as BG, CZ, EE, LV, PL, RO and SK. It should not therefore be concluded that the findings of the slaughterhouse survey indicate that operators are using currents below existing legal minimums.

In addition to this, it may be argued that the presence of an animal welfare officer will lead to better animal welfare, given that, according to the Regulation, *“the experience gained in some Member States has shown that the appointment of a specifically qualified person as an animal welfare officer to coordinate and follow up the implementation of animal welfare operating procedures in slaughterhouses has provided positive welfare benefits.”* The current requirement for an animal welfare officer has only been identified in the UK and Germany (section 2.4.3). This means that the production of the other 25 Member States; some 4.8 billion birds (75% of total EU production) will benefit from improved animal welfare.

### 3.2.2. Economic impact of the baseline

During the course of the study, interviewees explained that the introduction of Regulation (EC) No 1099/09 is likely to have three main areas of economic impact:

- costs for equipment compliance;
- economic impacts through changes to quality as a result of specified stunning parameters for waterbath stunning, and;
- personnel costs for animal welfare officers.

These three areas of economic impact will be examined individually.

#### 3.2.2.1. Costs for equipment compliance

Under the Regulation, existing slaughterhouses have until 8 December 2019 to comply with the layout requirements set out in Annex II. Interviewees generally thought that changes would only have to be made to slaughter lines with waterbath stunners; the consensus is that CAS stunners will have little difficulty complying with the provisions of the Regulation. This finding was also corroborated by our slaughterhouse survey<sup>58</sup>.

Evidence collected during our study suggests that there are three broad scenarios with regard to changes needed for compliance with Annex 2 of Regulation (EC) No 1099/09:

1. **Minor or no changes required.** This will be the case for relatively new plants where the latest generation of processing equipment is used. In many cases these slaughterhouses will already comply with Regulation (EC) No 1099/09, but some may need to install equipment to record the stunning parameters used. Evidence from our slaughterhouse survey suggests that the average age of plants requiring only minor changes is 8-9 years (versus 6-7 years for plants which require no modifications), and the average cost of minor changes is estimated by slaughterhouses to be around €12,000.
2. **Major changes required to existing system.** Many slaughterhouses will need to make substantial changes to their equipment. These changes will be possible without replacing part or all of the line, but may be relatively extensive. Evidence from our slaughterhouse survey suggests that the average age of plants requiring major changes to the existing system is 14-15 years and the average cost of these changes is around €42,000.

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<sup>58</sup> 50% of slaughterhouses with CAS in the survey believed they complied already, compared to 31% of slaughterhouses with waterbath stunners. Slaughterhouses with CAS which believed they needed changes thought these to only be minor in nature.

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3. **New system required.** Where very old equipment is used it may be necessary to change the waterbath and other parts of the processing line in order to comply with the Regulation. In these cases it may be necessary to increase the size of the building to accommodate a new processing line and some slaughterhouses will face planning and/or construction constraints. Evidence from our slaughterhouse survey suggests that the average age of plants requiring major changes to the existing system is 18-19 years and the average cost of changes is just under €950,000. However it should be noted that some interviewees felt the cost could run into several millions where slaughter lines have to be entirely reconfigured and/or buildings must be expanded. This implies that the cost estimate for this scenario in the slaughterhouse survey may be a substantial underestimate.

While it is difficult to estimate the proportion of slaughterhouses falling into each category given the absence of data on the age of slaughterhouses across the EU, our slaughterhouse survey does provide an indication. A third of respondents felt that no changes would be required; 23% felt that minor changes would be required; 23% that major changes would be required and 18% that a new stunning system would be required. In reality there are likely to be significant differences between Member States in terms of the levels of changes required. In north western Member States such as Germany, where many slaughterhouses have recently converted to CAS, changes are likely to be relatively minor for most operators, while in some southern and eastern Member States with older slaughterhouse buildings and/or equipment, changes are likely to be more significant and will affect a larger number of operators. With regard to changes for the 12 new Member States, it was pointed out by some interviewees that this will be the second time in recent years that they will have to make changes to their slaughterhouses; however some other interviewees pointed out that the changes they made both pre- and post-accession may have reduced the level of changes required to comply with Regulation (EC) No 1099/09.

While the majority of the layout requirements under Annex II were not considered difficult to comply with, a few requirements were repeatedly mentioned as being potentially problematic. These are:

- **One minute hang time prior to stunning.** On balance, this was considered the most problematic layout requirement. It was explained that old slaughterhouses often had longer hang times, as did some smaller slaughterhouses due to the low line speed. In some cases, turkeys are hung directly from the back of trucks (rather than being unloaded) and in these cases the hang time certainly exceeded one minute. One interviewee mentioned that longer hang times had been encouraged many years ago in some southern and eastern Member States in order to calm birds. In the case that the hang time is exceeded, it was felt that significant alterations would be needed to the line in order to comply, and that the cost of this could run in to several million Euros if alterations to lairage and transport systems are also required.
- **Device for recording parameters.** The issue with the device for recording parameters was not the device itself, but rather the lack of clarity as to the exact requirements of such a device (e.g. frequency of recording, exact parameters to record). This lack of clarity was considered to be an issue in the case that a Competent Authority finds a recording device to be inadequate.

Manufacturers indicated to Agra CEAS that the cost of such a device would range from €15,000-



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€50,000, depending on exact configuration (for example, whether the device is sold alone for connection to a computer, or as a complete recording solution with computer and database).

- **Access to the birds.** Some interviewees believed that accessibility to the birds on the slaughter line up to entry in the scald tank may be problematic. The bleeding rail and waterbath itself were identified as potential points of the line which may cause problems. The degree to which this may cause a problem was seen to depend on the interpretation of the Competent Authority. No information on the economic impact of this requirement was provided or found in the literature.

On the other hand, some requirements under Annex II are believed to already be in place, for example, many interviewees felt that breast plates were already in widespread use across the EU<sup>59</sup>.

### **3.2.2.2. Economic impacts through changes to quality obtained through waterbath stunning**

There is a widespread expectation in the industry that the quality obtained from waterbath stunning using the parameters in the Regulation will decrease compared to current practice where the electrical parameters in use are, on average, below those in the Regulation (see section 3.2.1). EFSA (2012) states “*it is obvious however, that one very important factor influencing the choice of the stunning and killing method is the quality of the meat resulting from the slaughter*”.

As seen in section 2.6.4.1, the quality of meat obtained from a waterbath system depends on various factors, although not all of these are related to the electrical parameters used. In turn, the degree to which quality will deteriorate through the use of the parameters in the Regulation will also depend on various factors; most notably the parameters which are presently in use, but also other factors mentioned in section 2.6.4.1, and the exact parameters which are used under the new Regulation. Estimates regarding the impact on meat quality as a result of the new parameters provided by interviewees ranged considerably, from a minimal impact to some 60% to 100% of breast fillets being damaged. To an extent this difference between estimates reflects the range of factors which can impact the changes in quality. However, it should be noted that no interviewees were able to provide concrete data (e.g. from studies, either internal or independent) to back up any estimates that were provided. Several interviewees believed that the industry may not have completed a full investigation of the quality impacts of all parameters (implying that the estimates provided were based either on informal tests or on personal impressions). However, one industry interviewee explained that such data on quality impacts and information on how an individual slaughterhouse will react to the parameters in the Regulation is often considered to be commercially sensitive and this may explain the lack of supporting evidence provided. In summary, while interviewees provided varying estimates regarding the impact of stunning parameters under the Regulation, it is not possible to corroborate these estimates with documentary evidence.

With regard to the precise parameters used by individual slaughterhouses following the entry into force of the Regulation, there was a consensus among interviewees that stunning using 100mA at frequencies under 200hz would have significant quality impacts. Fewer comments were provided

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<sup>59</sup> Poland is an exception to this.



about the combination of 150mA with 200-400hz, though on balance it was felt these parameters would also have significant impacts on quality. One interviewee believed that there was the potential to minimise negative impacts on quality by using high frequencies, around 1,500hz, in combination with a current of 200mA. According to this interviewee, who is familiar with various combinations of parameters in operation, at 200mA and 1,100hz, there was a slight deterioration in quality, while at 200mA and 1,500hz the stun was not effective<sup>60</sup>. However, this interviewee explained that only around 20% of waterbath stunners in the EU are able to stun at frequencies above 1,000hz, and that many waterbath stunners cannot stun at frequencies above 400hz. The implication of this is that only a limited number of slaughterhouses can stun at these higher frequencies in order to minimise negative impacts on quality.

Given the wide range of factors which will influence changes in quality with the entry into force of the Regulation, quantifying the economic impact of quality losses is challenging. Furthermore, there is extremely limited literature on the impact of different parameters on meat quality (as indicated above). The issue of quality was unfortunately not examined by EFSA during their investigation into the effectiveness of stunning using different parameters. Most literature which contains some data on the impact of parameters on meat quality either is very old (e.g. Veerkamp, 1983 and Veerkamp, 1988), or focuses primarily on other issues and as a result only examines the impact on quality of one single set of waterbath parameters<sup>61</sup> (e.g. Lambooij *et al*, 2010 and LEI, 2012). Only one fairly recent study which specifically examines the impact of more than one set of waterbath parameters on meat quality was identified during the course of the study (Barker, 2006). This study was in turn used as the basis for an impact assessment by Defra (2012) which quantified the economic impacts for the UK in the case that there is a slight change to the frequencies permitted under the middle 150mA band. This work by Defra can be used as the basis for EU level estimates.

The Defra study quantifies the losses through trimming for two sets of parameters: DC 80mA and 600hz (which is meant to represent the *status quo*) and AC 150mA and 600hz (which is meant to represent stunning under the Regulation). The *status quo* parameters are slightly below the average parameters which were found to be in use in the EU at present (101mA and 370hz according to our survey). The parameters which are meant to represent the Regulation are also slightly lower than those in the actual parameters in the Regulation (frequency is 600hz rather than 400hz which will be the limit under the Regulation). However, given that the parameters in the Defra study are only slightly different from those presently in use and those outlined in the regulation, and in the absence of any other usable data on meat quality, these are used to assess the likely impact on quality under the Regulation. It should be noted that the direction of difference is the same (i.e. both are likely to slightly underestimate negative quality impacts), and it is therefore assumed that the difference between trimming at these two settings is a reasonable reflection of the difference between trimming at present and trimming under the Regulation.

<sup>60</sup> In this context, it is worth noting that the UK has asked EFSA to make slight changes to the sets of parameters allowed under the Regulation, more specifically: a ban on frequencies above 800hz as they do not produce an effective stun; and an alteration to extend the middle band (150mA) to 200-600hz.

<sup>61</sup> For the reasons already outlined, it is not possible to meaningfully compare the results of different studies which record the impacts on meat quality of one single set of parameters.

At DC 80mA and 600hz, an average of 4.3% of birds require trimming or downgrading. At AC 150mA and 600hz this figure increases to 10.3% implying a difference of 6% (i.e. 6% more birds will require trimming). While there is no data on the degree of trimming per breast that will be necessary, Defra (2012) assumes that between 10% and 30% of the breast will be lost through trimming. This loss of 10-30% per bird requiring trimming (6% of all birds slaughtered) equates to an industry-wide additional loss of breast meat through trimming of between 0.6% and 1.8% of breast meat. This range is coherent with an estimate of an additional 1% loss through trimming provided by one equipment manufacturer based on limited feedback from Dutch slaughterhouses.

This difference in the need to trim can then be converted into economic terms. The price of chicken breast across the EU varies. Defra assumed a breast fillet price of €5.00 (£4.00) per kilogram. Data from DG Agri shows UK poultrymeat prices to be some 19% below the EU average. Assuming similar costing of cuts in other Member States, breast fillet will cost €6.18 per kilo on average in the EU. Defra assumes that the trim can be sold for one third of this price (i.e. €2.06 per kilo; a loss of €4.12 per kilo). Defra assumes an average breast fillet weight of 300 grams per bird; one interviewee indicated that breast fillet normally weighed around 250 grams. Using the average of the two estimates (275 grams), extra downgrading of between 0.6% and 1.8% of breast meat will result in an additional loss through trimming of between 1.65 and 4.95 grams per bird, which in revenue terms translates to 0.7 to 2.0 cents per bird.

To summarise, using the parameters from Defra (2012) as a proxy for the *status quo* and the Regulation<sup>62</sup>, the introduction of the Regulation is estimated to lead to a revenue loss of between 0.7 and 2.0 cents per bird, assuming that the trim can be sold at a lower price. This loss is only applicable to deboned birds, not to birds sold as whole chickens. Losses may also be lower in the case that the bird is deboned and the breast used for further processing. However, if the trim cannot be sold at one third value, the loss range will increase to between 1.0 and 3.1 cents per bird. While there is no source of data on the proportion of birds sold as deboned meat, evidence from case study countries suggests it is likely to be in the region of 50% of EU production, therefore the losses indicated above are likely to affect around 50% of EU waterbath production (about 40% of total EU production, some 2.35 billion broilers,).

It should be noted that there are additional factors that may affect the global revenue loss positively or negatively. The two main factors are:

- **Economic loss through downgrading, lack of market access and the cost of trimming.** The calculations above only take into account revenue losses through trimming itself. The trimming itself may incur additional costs which may increase overall industry losses. In some cases, the breast may be downgraded despite trimming, leading to a lower price being received per

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<sup>62</sup> As explained above, while the parameters from Defra are below those currently in use and those specified in the Regulation, given the direction of difference is the same (i.e. an underestimate) and the difference is relatively small, the difference in quality calculated based on Defra (2012) is considered to be a fair proxy of the difference in quality between stunning at present and stunning under the parameters of the Regulation.

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kilogram. Similarly, it is possible in some cases that market access will be lost due to poorer quality. Section 2.6.4 contains a full discussion on the relationship between quality aspects and revenue.

- **Implementation of the Regulation.** It was seen in section 3.1.2.1 that there are possible implementations of the religious slaughter derogation which may allow slaughterhouse operators to stun using lower parameters and thereby circumvent potential quality issues. It was estimated that this could be the case in between a third and half of Member States. If it is possible for operators in some Member States to circumvent quality issues, overall industry losses will be lower.

### **3.2.2.3. Personnel costs for Animal Welfare Officers**

The extra personnel cost for Animal Welfare Officers was identified as a further economic impact of the Regulation. Assuming the presence of one extra staff member due to this requirement, higher capacity slaughterhouses will incur lower additional per bird costs than lower capacity slaughterhouses. Using the EU average employment cost of €23.10 per hour, the additional cost for a 12,000 bird per hour slaughterhouse will be 0.1925 cents, compared to 0.77 cents for a 3,000 bird per hour slaughterhouse. The real additional cost will depend on national wage rates which vary between Member States. Furthermore, it is possible that slaughterhouses will delegate the role to an existing member of staff rather than hire a new employee, and in doing so, may effectively incur no (or minimal) additional costs. It should be noted that there will be no extra costs where Animal Welfare Officers are already in place, either as a national requirement (UK and Germany) or where these are employed by individual slaughterhouses.

### **3.2.3. Other impacts of the baseline**

#### **3.2.3.1. Competitiveness of EU slaughterhouses operators**

##### **Distortion within the EU**

In general terms, the entry introduction of Regulation (EC) No 1099/09 will reduce the risk of distortion in competition between Member States. That said, it was seen in section 3.1.3 that while the legislative baseline can be considered uniform at the EU level, there may be differences in national implementation which result in some distortion within the EU. Most notably:

- Differences in interpretation and implementation of the religious slaughter derogation may provide the opportunity for operators in some Member States to at least partially avoid negative impacts on quality. Several interviewees expressed concerns that implementation in some Member States may lead to operators in these Member States being advantaged vis-à-vis operators in the rest of the EU.
- Differences in requirements for the certificate of competence were identified as a potential source of harmonisation problems. However, the economic impacts of this are likely to be limited.

The economic impacts of the baseline were identified in section 3.2.2. It is likely that there will be some differences in the economic impacts between Member States. Most notably:

- The employment costs for the Animal Welfare Officer will be closely connected to wages in each Member State. The extra cost will therefore be lower in Member States where wages are lower.

- There will be some differences in the degree of layout changes required in different Member States. Most notably, the costs are likely to be more substantial in Member States with smaller and/or older slaughterhouses.

### **Distortion vis-à-vis Third Countries**

There are two aspects to distortion vis-à-vis operators in Third Countries:

- distortions on the EU market; and,
- distortion on export markets on which EU operators compete with Third Country operators.

With respect to the EU market, the provisions of Regulation (EC) No 1099/09 will apply to Third Country operators as well as those operating within the EU<sup>63</sup>. Operators in Third Countries exporting to the EU will therefore face the same economic impacts as operators based within the EU. More specifically, given that the EU imports primarily breast meat, Third Country operators are likely to face the quality impacts outlined in section 3.2.2.2 (though the level of trimming required may vary depending on the destination market of the chicken breast<sup>64</sup>). Third Country operators will also incur the cost of the Animal Welfare Officer, although given that wages in the major importing Third Countries such as Brazil and Thailand are relatively low, the cost of implementing this requirement is also likely to be lower. Assuming the Regulation is fully implemented in Third Countries, there is therefore likely to be little, if any distortion between EU and Third Country operators on the EU internal market. One interviewee commented that if the provisions of the Regulation are deemed to be excessive by Third Country operators, they may cease production for EU markets and concentrate on other import markets, most notably Middle Eastern markets. If this were to happen, there could be impacts on the supply of poultrymeat to the EU. Imports account for only 6% of total production so any such impact is likely to be limited, though it should be remembered that imports tend to be of breast meat only (which represents approximately 20% of the bird's weight).

EU operators are likely to be disadvantaged vis-à-vis Third Country operators on export markets for the following reasons:

- EU operators will incur additional costs from implementation of the Regulation; most notably the costs of changing layout requirements, which may be significant, and also the cost of the Animal Welfare Officer. This will provide a competitive advantage to Third Countries where these costs are not imposed.
- Given that the EU exports primarily unwanted cuts, the reduction in the quality of breast fillet is unlikely to be a problem. However, any reduction in the quality of the cuts may have impacts in terms of downgrading<sup>65</sup>. There will be no issues arising from trimming where whole birds are exported; however there may be revenue or market access impacts if, over time, the quality of whole birds is judged to be lower.
- EU operators will be disadvantaged vis-à-vis Third Country operators in terms of production for Halal markets. It has already been established that the new parameters for waterbath stunning are

<sup>63</sup> Chapters 4 and 5 of the Regulation, which deal with the Competent Authority, compliance and penalties do not apply. The implication is that penalties for non-compliance do not apply, but that permission to export to the EU would be jeopardised in such cases.

<sup>64</sup> Imports tend to go into catering and processing, and may be less affected by trimming as a result.

<sup>65</sup> It should be noted that no work has been identified on the impact of the Regulation on the quality of other cuts. However it is reasonable to expect that the quality of some cuts will deteriorate. Where these cuts are sold with skin, quality will be less of an issue.

not acceptable for Halal, and interviewees explained that Muslim Third Countries do not generally accept CAS for Halal slaughter. In the case of whole bird production for Muslim Third Countries, EU operators may be able to operate under the religious slaughter derogation. However, whether operators are able to produce under the religious derogation if they are primarily producing breast meat for the EU internal market and exporting some cuts will depend on the way this issue is approached by Member States. To put the importance of exports to Muslim countries in context, according to 2008 figures, 16% of EU exports were destined for Middle Eastern countries, and a further 17% were destined for other countries with a significant Muslim population<sup>66</sup>. Together these account for one third of EU export market, i.e. a volume equivalent to 3% of total production. The impact of the loss of these markets will depend on various factors. If other markets with similar prices can be found, there will be no impact; however if either other markets cannot be found, or only markets with lower prices can be found, EU operators will face economic losses, or will need to recover the value of the cuts through the price received for the breast fillet.

In summary, while EU operators are not likely to be significantly disadvantaged vis-à-vis Third Country operators on the EU domestic market, they are likely to become less competitive on export markets, primarily for reasons of market access rather than increased costs. As was seen in section 2.7, differences in stunning costs are minor when set against feed, labour costs, and exchange rates, and any increases in stunning costs are likely to remain minor compared to these other factors.

### **3.2.3.2. Ensuring consistency with other EU policies**

In Article 13 of the Treaty on the Functioning of the European Union (TFEU), it is stated that: *“In formulating and implementing the Union’s agriculture...policies, the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals, while respecting the legislative or administrative provisions and customs of the Member States relating in particular to religious rites, cultural traditions and regional heritage.”*

Regulation (EC) No 1099/09 can be considered consistent with Article 13 in that the Regulation will provide for a higher level of animal welfare. In allowing Member States to go beyond the Regulation, it respects legislative and administrative customs. Religious rites are respected through the religious slaughter derogation. However, the ability for Member States to go beyond the Regulation, and the potential for some different interpretations may conflict with Article 40 of TFEU on a common organisation of agricultural markets.

The requirement for staff involved in slaughter to hold a certificate of competence can be considered coherent with the existing requirement for the personnel of transporters and assembly centres to hold a certificate of competence under Regulation (EC) No 1/2005.

Finally, the scope of the Regulation in covering all species can be considered coherent with other pieces of legislation such as Regulation (EC) No 1/2005 on the protection of animals during transport.

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<sup>66</sup> These are countries in Africa with 20%+ Muslim population; Middle Eastern countries; Muslim ex-USSR republics; Malaysia; and Indonesia.

### **3.2.3.3. Other social impacts**

#### **Regional**

The distribution of slaughterhouses within Member States varies. Our case studies indicated that in some Member States such as Spain, and to a lesser extent Italy and Poland, slaughterhouses are smaller, individual slaughterhouse concentration ratios are low and there is a large number of slaughterhouses spread across the country. In other Member States such as Germany, Sweden, and the Netherlands, slaughterhouses are larger, individual slaughterhouse concentration ratios are high and slaughterhouses are often concentrated in certain regions.

Some interviewees expressed concerns that the cost of compliance with the layout requirements of Annex II may, in time, force some slaughterhouses (most likely smaller ones) to close, thus encouraging further concentration in the sector. If this were to occur in Member States with more regionalised production (such as Spain) there will be negative social impacts on any region in which slaughterhouses close. It should also be noted that if slaughterhouses are to close in a region, there may be negative impacts on animal welfare due to increased transport times to slaughter (Kjærnes, *et al*, 2007). This additional transport time will also have some environmental impacts in terms of additional greenhouse gas emissions.

#### **Religious groups**

It was seen in section 3.1.2.1 that there are different possible interpretations and implementations of the religious slaughter derogation. This will in turn affect the impact on religious groups.

In any situation where the interpretation of the religious slaughter derogation only permits slaughter without stunning, the cost of production for religious slaughter will increase due to the reduction in mechanisation and requirements for slaughter by hand. No estimates were provided for this extra cost, although it will be directly linked to the cost of the slaughtermen. For example, where a slaughterman can manually slaughter 500 birds per hour and the cost of employment is the EU average of €23.10 per hour, the additional cost will be in the order of 4.62 cents per bird<sup>67</sup>. The extra cost will fall on communities requiring religiously slaughtered meat. Under an interpretation of the religious slaughter derogation which permits slaughter with stunning at parameters outside those in the Regulation there will be no additional cost under the Regulation<sup>68</sup>.

Finally, any situation which fully prohibits religious slaughter (as is the case in Sweden) may risk marginalising certain religious groups (although imports will still be available).

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<sup>67</sup> Higher rates of manual slaughter and/or lower labour costs, will lead to this cost being lower.

<sup>68</sup> It was explained that there are additional costs for halal poultrymeat slaughtered with stunning, most notably the presence of a Muslim slaughterman by the neck cutter and possibly the loss of a small part of the bird's neck which would normally be used for petfood. However in mechanised systems, this additional cost can be split across the total throughput of the slaughterhouse, and hence becomes comparatively low. In any case, these costs are incurred under the current legislation so the introduction of Regulation (EC) No 1099/09 will not impose additional costs.



### **Social impacts for slaughterhouse staff**

Under the baseline, staff involved in the slaughter process will require training and a certificate of competence. It is possible that this training will have some positive social impacts in terms of employee satisfaction. It is also possible that there will be a very slight increase in employment due to the requirement to have an Animal Welfare Officer.

### **3.2.3.4. Environmental impacts**

It was seen in section 2.6.5.3 that differences in the environmental impacts of stunning systems is a political issue in terms of which environmental media are considered to be more important. Furthermore the environmental impact of the changes made under Regulation (EC) No 1099/09 are limited in the context of the wider stunning process.

The only changes to environmental impact during the stunning process resulting from the entry into force of the Regulation are slightly higher electricity use due to the use of higher currents and possible increases in waste streams. The change in electricity use is considered insignificant in the context of the overall slaughter process. The change in waste streams through trimming may be more significant in the case that trimmings are considered waste. However, where possible they will be diverted to low value markets (for example, petfood) and there will be no additional waste. If there is an increase in slaughterhouse concentration as a result of the impact of the Regulation there will be longer transport times (see section 3.2.3.3) which will imply a negative impact on greenhouse gas emissions.

On balance, changes in terms of environmental impacts directly due to the baseline are minor.

## **4. The feasibility of phasing out multiple-bird water bath stunners**

In this section, the feasibility of phasing out multiple-bird waterbath stunners will be examined. First, the likely evolution of stunning systems under the baseline will be presented. Second, voluntary incentives for discouraging the use of multiple-bird waterbath stunners will be examined. Next, the feasibility of a partial or complete ban on multiple bird waterbath stunners will be analysed. Finally, indicators for monitoring and evaluation will be presented.

### **4.1. Likely evolution under the baseline scenario**

From section 3.1, it can be seen that the legislative baseline is fairly uniform across the EU. While a few Member States indicated that they may introduce legislation which goes beyond Regulation (EC) No 1099/09, no details are available at present. Based on evidence collected, it is the view of the contractor that any additional national measures are likely to be relatively minor and will not have any significant differential impact on the stunning systems used. It was seen in section 3.1.2 that there are some potential implementation differences which could have an impact on the attractiveness of different systems under the Regulation. However it is unlikely that different implementation of the religious slaughter derogation will be a key factor in the evolution of stunning systems going forwards.



During the course of this study information has been collected on the past, present and future drivers for choice of stunning system. These have been discussed in various sections of this report and are brought together below:

- **Working conditions.** CAS can provide advantages over multiple bird waterbaths stunners in terms of working conditions. In some cases, especially in turkey slaughterhouses, the advantage in working conditions was considered a major driver for the installation of CAS systems. This was mentioned as a factor in Austria, Germany and France.
- **Mechanisation and the reduction of labour inputs.** Greater mechanisation is possible with CAS systems and as a result, labour costs can be reduced. This is reflected in our cost model (section 2.6). This will make CAS more attractive for larger slaughterhouses in Member States with higher wages (e.g. Germany and the Netherlands).
- **Quality and revenue issues.** The issues of quality and revenue have been discussed in section 2.6.4. It is clear that when producing for certain markets, one stunning system may offer advantages in terms of quality and/or revenue over other stunning systems. In this context, some interviewees believed that the impact of the electrical parameters in the Regulation may in some cases prompt slaughterhouses to investigate alternative systems.
- **Cost issues.** The cost model showed that multiple bird waterbath stunning is the cheapest system. Unless there are market access issues or there is an opportunity to capture additional revenue, waterbath stunning is therefore likely to be preferred from an economic point of view.
- **Access to capital.** An important consideration in the current economic climate is the ability of slaughterhouse operators to carry out investments. Access to capital will vary across the EU, but may not be possible in Member States which are most exposed to economic difficulties.
- **Installation problems, including space issues/building modifications and planning requirements.** CAS systems require a different layout of the slaughter line and generally require more space. This means that in some cases buildings will need to be modified to allow a CAS system to be installed. Where this is the case the cost of installing a CAS system will be greater and there may be additional complications in terms of obtaining planning permissions. This is more likely to be an issue in Member States with older and/or smaller slaughterhouses, as is understood to be the case in many of the 12 new Member States.
- **Slaughterhouse size.** The cost model showed that the differences in cost between systems narrow as slaughterhouse throughput increases, making CAS systems more attractive in relative terms for larger slaughterhouses than for smaller ones. This was reiterated by interviewees who generally believed CAS to only be an economically viable option for slaughterhouses with a throughput of over 6,000 birds per hour. Interviewees also commented that CAS systems in operation in the EU generally have a throughput of at least 7,000 birds per hour.
- **Volume of domestic production/size of the domestic market.** Connected to the previous point, in some Member States, domestic production may not be large enough to support a slaughterhouse with a CAS system, or if the market is sufficiently large, it may only be able to support one slaughterhouse. This will be an issue in very small Member States<sup>69</sup>.

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<sup>69</sup> Assuming that CAS slaughterhouses are only viable at throughputs of above 7,000 birds per hour, national production of at least 14 million birds per year is required to support a single CAS slaughterhouse. Annual production of broilers in CY, EE, LU and MT is below this figure, while annual production in LT is only slightly above.

- **Private initiatives.** Section 3.1.2.4 showed that there are already private initiatives with stunning requirements in force in certain Member States. The presence of such private initiatives, and more notably any pressure from retailers to use a certain type of stunning system may influence a slaughterhouse's choice. Evidence gathered during the present study suggests that such private initiatives were present in only a few north-western Member States.
- **Public sensitivity to animal welfare and consumer demands.** The sensitivity of the public to animal welfare issues may lead to CAS systems being seen more favourably in certain Member States. However, this is not always the case with consumers in Poland having a negative perception of the use of CAS. Consumer demand could therefore favour either system depending on local perceptions.
- **Production of Halal meat.** The acceptance of a stunning system for the production of Halal meat may play an important role. While CAS is accepted for Halal slaughter in Germany, all evidence suggested that it is currently not accepted in other Member States and Third Countries. Slaughterhouses wishing to produce Halal meat, whether it be for their domestic market or Third Countries, may therefore prefer waterbath stunning.

An extrapolation of these drivers against the background of the baseline is set out in Table 4.1 below.

**Table 4.1: Development of stunning systems for broilers under the baseline (short to medium-term: 2-5 years)**

Current situation	Likely future situation	MS	Comments
Waterbath only	Waterbath only	CY, EE, LT, LU, MT.	Internal poultry market considered too small to support a slaughterhouse with CAS.
Waterbath only	Low conversion to CAS (e.g. 10% or less of throughput)	PL	The majority of evidence suggests that there are significant barriers to the adoption of CAS in Poland. However, given the significant levels of production for export, including to Germany, the Netherlands and the UK, it is considered possible that a small proportion of slaughterhouses will convert to CAS, while the majority will continue to use waterbaths.
		BG, CZ, HU, LV, RO, SI, SK	Evidence suggests that conversion to CAS in these Member States is unlikely, with the possible exception of Hungary. Nonetheless, some interviewees indicated that with time, and with access to breast fillet markets in north-west EU, there may be some limited conversion. This set of Member States is therefore considered as a group, and it is considered possible that around 10% of production from this group may in time come from CAS systems.
Waterbath only	Moderate conversion (e.g.	IE, EL, DK, PT	There is very limited information on these Member States. In Ireland it was felt that

Current situation	Likely future situation	MS	Comments
	30%) possible		retailer demands could drive conversion, but capital costs would be problematic. Capital costs, the lack of a premium and religious slaughter issues were seen as holding conversion back in Denmark. Given the fairly small size of these Member States, the conversion of one large slaughterhouse could result in a significant proportion of poultry production being stunned with CAS. Moderate conversion is therefore considered possible, but by no means certain.
90%+ waterbath	No change	ES	Evidence from the case study suggests that further uptake of CAS stunning in Spain is unlikely, at least for broilers (the main species).
90%+ waterbath	80-90% waterbath	FR	The situation in France was considered unlikely to change significantly, particularly given the large number of small slaughterhouses. Nonetheless, some limited conversion was considered possible due to quality issues resulting from the use of parameters under the Regulation.
~80% waterbath, 20% CAS	<50% waterbath, >50% CAS	NL, BE	A trend in recent years towards CAS was identified in the Netherlands. It was felt that going forwards, a combination of quality issues and consumer demands and public sensitivity could drive further conversion. The situation in Belgium is considered to be similar to that in the Netherlands.
~70% waterbath, 30% CAS	60-70% waterbath, 30-40% CAS	IT, SE	There were mixed views on the likelihood of conversion in Italy. The large number of medium and small-sized slaughterhouses in Italy makes large scale conversion unlikely. However there may be a small increase in the use of other systems. In Sweden, the feeling was there may be some small-scale conversion following any further industry consolidation.
~65% waterbath, 35% CAS	40% waterbath, 60% CAS	UK	Larger slaughterhouses are expected to convert to CAS, while smaller slaughterhouses remain with waterbaths. Public opinion/NGO pressure, private labels and retailer pressure were identified as key reasons for conversion. It is also likely that slaughterhouses using inert gas systems will convert to CO <sub>2</sub> systems when reinvestment is required.

Current situation	Likely future situation	MS	Comments
~40% waterbath, 60% CAS	20% waterbath, 80% CAS	DE, AT	In Germany there has been a significant trend towards CAS stunning in recent years and interviewees considered it likely that this trend will continue. The main reasons for this are mechanisation, working conditions and meat quality. Only small slaughterhouses are expected to use waterbaths in the future. The situation in Austria is considered to be similar.
~10% waterbath, 90% CAS	~10% waterbath, 90% CAS	FI	Evidence suggests small slaughterhouses will continue to use waterbath systems and in the absence of an alternative, it is unlikely that the situation will change.
79% waterbath 21% CAS	~65% waterbath ~35% CAS	EU-27	<b>Average estimate indicated. Full estimated range of 60-70% waterbath, 30-40% CAS.</b>

## 4.2. Voluntary incentives for the phasing out of waterbath stunning systems

During the course of the study, two potential voluntary incentives for phasing out multiple-bird water bath stunners were identified and examined. These were labelling and financial support for slaughterhouse conversion. These two incentives are examined in the sections below.

### 4.2.1. Labelling

#### 4.2.1.1. Nature of labelling

Interviewees almost unanimously agreed that neither consumers nor Food Business Operators (including multiple retailers) would want to see the explicit mention of slaughter method on the packaging of meat. Two alternative methods of labelling were identified:

- A numbering system, similar to that in use in the egg sector;
- Labelling as a requirement of a broader animal welfare assurance scheme which also covers other aspects of production (in line with options for animal welfare labelling developed by DG SANCO (European Commission, 2009)). One FBO interviewee explained that their company communicates through standards with reputable partners rather than on individual product aspects, and other interviewees saw merits in this less specific form of labelling. This approach to labelling is similar to that taken by the private label schemes already in use in some Member States (see section 3.1.2.4).

#### 4.2.1.2. Effectiveness of labelling

Brook Lyndhurst (2010) states that reported consumer concerns over animal welfare do not appear to translate into purchasing decisions. While a minority of our interviewees felt that labelling may be an effective voluntary incentive, the majority felt that it would not be effective in encouraging a move away from waterbath stunning. In some case study Member States, such as Italy, Spain and Poland there is a relative lack of consumer interest in or awareness of animal welfare issues which means that labels would not be used in a purchase decision (for example, Vecchio and Annunziata (2011) found

general unawareness of production systems in the egg sector in a survey of Italian consumers). In other Member States such as Germany and the UK where such labelling was perceived to be effective, private labelling schemes containing slaughter provisions either already exist or are being finalised. It is therefore unlikely that the introduction of widespread and co-ordinated labelling would have significant impacts on the evolution of stunning systems under the baseline in any Member State (Table 4.1).

In addition to the perceived lack of effectiveness of labelling, some interviewees believed that consumers are already faced with a substantial amount of product information (see also, for example, Sørensen et al (2012)). Furthermore, any requirement to label will add additional costs through traceability/assurance and design/printing without bringing benefits.

#### **4.2.1.3. Summary**

While a number labelling system, similar to that which exists in the egg sector is a potential method of informing interested consumers with information on the method of slaughter, it is unlikely that such a labelling scheme would be effective in prompting consumer avoidance of multiple-bird waterbath stunners. However, in Member States where retailers are already expressing a preference for the use of alternative systems, such an approach could play a marginal role in reinforcing this. The costs of traceability and assurance would need to be investigated in order to further consider the merits of such an approach.

#### **4.2.2. Financial support for slaughterhouse conversion**

Financial support for voluntary conversion from waterbaths to alternatives systems was mentioned as a potential method of encouraging conversion by several interviewees. The offer of financial support directly tackles one of the major barriers to conversion from waterbath systems, namely installation cost. While it was felt that financial support may encourage conversion in some Member States (e.g. Poland), in others it was felt that there were other barriers to conversion such as slaughterhouse size, consumer preference and experience (e.g. Spain) which would remain unaddressed. In summary, financial support may encourage the phasing out of waterbaths in Member States where the main barriers are considered to be cost and access to capital (as was identified to be the case in France, Poland, Sweden, and to a certain extent Germany, the Netherlands and UK among case study Member States). However, in Member States where other barriers exist (as was identified to be the case in Italy, Spain, and Romania among case study Member States) such an incentive will be less effective.

The exact functioning of a mechanism for offering voluntary support would require further investigation. While some interviewees mentioned the Rural Development Regulation (RDR)<sup>70</sup> as a possible mechanism, it is the understanding of the contractor that it would be difficult to develop an intervention rationale for providing support for slaughterhouse investment. Any kind of support under the RDR would need to be offered at the regional/national level and it is likely that some Member States would choose not to implement such a measure which would result in a different operating

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<sup>70</sup> Council Regulation (EC) No 1698/2005.

environment for the poultry sector in different Member States. Furthermore, some interviewees expressed the opinion that any kind of support for financing would in fact unfairly advantage equipment manufacturers who produce CAS systems, and disadvantage those which produce waterbaths (including any companies working on improvements to the waterbath).

In summary, while financial support may be partially effective in phasing out waterbath stunning where investment cost is the only, or major, barrier, there are likely to be questions of equity between both Member States and equipment manufacturers.

#### **4.2.3. Other voluntary incentives or non-mandatory initiatives**

Other voluntary approaches or initiatives such as providing best practice guides and financing for innovation in order to improve existing systems are potential options which fall under the category of voluntary incentives.

Given the lack of alternatives to waterbath stunning, financing for innovation, both of alternatives to the waterbath system, and of improvements to the system may over time result in new or improved systems which tackle problems with waterbaths. That said, it has been seen in section 2.5 that several alternative methods have been investigated yet only waterbath stunning and CAS remain present in Europe at the time of writing. Public funding may therefore stimulate research, but there is no guarantee that it will result in commercially viable alternative stunning methods. One possible way of approaching the issue of public funding to stimulate research would be to focus funding on alternatives systems for species which at present may suffer more from waterbath stunning; most notably turkeys (which tend to be heavier) laying hens (which tend to be more fragile). With regard to improvements to the waterbath system, it is possible that both political discussions and the legislation itself have discouraged work in this area because these have suggested that the future use of waterbath systems is under debate. Financing for innovation may encourage work in this area, though it may also send out a conflicting signal with regard to the longer-term future of waterbaths.

While further evaluation of the use of waterbath parameters and the quality impacts of them is recommended (particularly given the absence of literature on the quality impacts of different waterbath settings), it is difficult to see how such work may encourage a change in stunning systems in use. Similarly, the development of best practices could have positive impacts on animal welfare, but are unlikely to encourage a voluntary move away from waterbaths.

In summary, interviewees believed that, in most cases, voluntary incentives to move away from waterbath systems would not work. That said, it may be worth further examining the possibilities of encouraging innovation, evaluating waterbath parameters (including the quality aspects) and establishing best practices as they may result in improvements to animal welfare.

#### **4.3. Mandatory phasing out of waterbath stunning systems**

As the terms of reference notes, EFSA recommended the phasing out of electrical stunning methods as soon as possible on animal welfare grounds. Our research has shown that waterbath stunning remains



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the most widely used method of slaughtering poultry in the EU, despite the availability of CAS systems. Our cost model has demonstrated that waterbath stunning is the cheapest method, although for large throughputs and where certain end markets are served, it is possible for the additional costs of CAS to be recouped through higher revenue. Table 4.1 shows that there is unlikely to be large-scale movement away from waterbath systems across the EU in the near future. A further problem is a lack of commercial alternatives for slaughterhouses with lower throughputs. Section 4.2 suggests that a voluntary phasing out of waterbath systems is unlikely to take place on an EU-wide scale, although some voluntary phasing out is likely to take place in north west Europe. Against this background, a mandatory phasing out of waterbath systems appears to be the only option to comply with EFSA's recommendation. The potential ways in which this might be done are considered below using PESTLE<sup>71</sup> analysis.

#### **4.3.1. Complete ban on the use of waterbath stunning systems**

In **political** terms, a complete ban on waterbath stunning systems would bring the industry into line with the recommendation of EFSA (EFSA, 2004) and with best practice as set out in European Commission (2005). On the other hand, it might be considered politically difficult to enforce a change in the operating environment soon after the implementation of Regulation (EC) No 1099/09 which foresees the use of waterbath stunning systems. It should also be noted that Regulation (EC) No 1099/09 will not be fully implemented until 2019.

Our research has identified greater concern over animal welfare at slaughter in some (predominantly north-west) Member States compared to others. A ban on waterbath systems might be seen in some Member States as following a regional rather than an EU-wide agenda.

In **economic** terms, a ban on waterbath systems would entail substantial investment in new equipment and would involve increased running costs as set out in section 2.6. In addition there would be a need to provide training in the operation of alternative systems. Whilst operators serving the high quality portion market might be able to obtain additional revenue as a result of a reduction in the need to trim breast fillet, this will not apply to operators serving the whole bird market. All operators might find access to certain Third Country markets denied where stun-to-kill slaughter methods are not accepted (although this might already be the case under the baseline). Finally, operators may be denied access to domestic religious markets where stun-to-kill is not accepted (again, this might already be the case under the baseline).

The main **social** impact would be a positive one in terms of animal welfare because live inversion and shackling and pre-stun shocks would no longer be a concern. Slaughterhouse operators would also have a more pleasant working environment with reduced risk of workplace injury (especially in relation to turkey slaughtering). On the other hand, CAS systems can entail a reduced labour requirement which would result in unemployment. If a ban on waterbath stunning systems were to accelerate the concentration of the slaughter sector then there may be social implications from the

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<sup>71</sup> Political, Economic, Sociological, Technological, Legal, Environmental.



closure of smaller slaughterhouses. This in turn might result in the need for increased transport times between farms and slaughterhouses which could have a negative impact on animal welfare (see also environmental impacts below). Finally, any increase in costs would ultimately be passed on to consumers, although slaughter costs make up a small proportion of final consumer prices.

The main **technological** issue is the current absence of a choice of commercial alternatives to waterbath stunning systems. This is especially a concern for smaller slaughterhouses where throughput is insufficient to make investment in a CAS system economically viable. Installation of a CAS system requires adaptations to the processing line which can require alterations to building layout. This may not always be possible and operators may also encounter difficulties in obtaining the necessary permissions for changes and/or for the storing of gas. That said, a ban on waterbath systems is likely to prompt research into economically viable alternative systems, especially for smaller-scale slaughterhouses. However, a ban would discourage EU research into modifications to waterbath stunning systems which remain the most widely used method of slaughter worldwide; this will reduce the likelihood of global improvements in animal welfare.

In **legal** or regulatory terms, a ban on waterbath systems would require a change to the existing regulatory framework which will not be implemented fully until 2019. Such a change would increase consistency between Article 13 of the Treaty on the Functioning of the European Union in terms of animal welfare, although suitable derogations would be necessary in order to provide consistency with the respecting of religious rites aspect of the same Article.

Section 2.6.5.3 set out the **environmental** differences between waterbath and CAS systems and concluded that there is little overall difference unless greater political importance is attached to certain environmental issues. Some (relatively minor) environmental impacts would result from increased farm to slaughterhouse transportation if smaller slaughterhouses closed as a result of a ban (see social impacts above). There could also be negative impacts in term of increased Third Country trade if cheaper imports replace some domestic production, although the extent of this would depend on where imports were sourced from and the transport method used. The environmental impact of a mandatory ban on waterbath stunning systems is therefore considered to be minimal.

Any complete ban on waterbath stunning systems would need to involve sufficient notice for the industry to write-off current investment and carry out new investment. A lengthy period of notice would mitigate some of the potential difficulties outlined above.

#### **4.3.2. Partial ban on the use of waterbath stunning systems**

There are a number of options relating to a partial ban on waterbath stunning systems and these are discussed below. The overall expected impacts are the same as a full ban and the analysis below therefore focuses on where impact would diverge from the above in the case of a partial ban. In all cases the differences from the full ban scenario relate to issues of equity across the sector.

#### **Partial ban based on slaughterhouse capacity**

In recognition of the lack of economically viable alternatives to waterbath stunning systems for slaughterhouses with lower throughput, a partial ban could be considered based on slaughterhouse capacity. The main advantages of this approach would be **economic** and **technical**. Larger slaughterhouses will be more able to raise capital for investments and can capture scale economies; smaller slaughterhouses will avoid technical difficulties in terms of a lack of suitable alternative systems. However, larger slaughterhouses would be exposed to the difficulties set out under a full ban in terms of access to religious markets and would have a different cost base imposed upon them while smaller slaughterhouses would not.

However, a **political** case might be needed for differential treatment. This would be necessary in terms of the rationale, i.e. if the rationale for a ban is to comply with EFSA's animal welfare opinion then a reason for not applying this to all slaughterhouses would be needed. Similarly, it would be difficult to justify the cut-off slaughterhouse capacity for a ban. The general consensus of interviewees was that CAS is not viable for slaughterhouses with capacities of under 6,000 birds per hour at present. However, it does not follow from this conclusion that CAS is viable for slaughterhouses with capacities of over 6,000 birds per hour; evidence collected during the present study suggests that slaughterhouses using CAS tend to have capacities closer to 10,000 birds per hour. In considering cut-off capacities for a ban, differences between species would also need to be taken into consideration<sup>72</sup>. In summary, these political issues would have to be examined in more detail prior to the introduction of a partial ban by slaughterhouse size.

Other impacts set out under a complete ban would apply only to slaughterhouses over a certain capacity in the case of a partial ban. More specifically, the **economic**, **social** and **environmental** issues would be the same for large slaughterhouse as those outlined in section 4.3.1. A potential **legal** issue could arise in terms of definitions. Capacity, depending on how it is calculated, is a function of scale, line speed and operating period and it would be possible for operators to make adjustments to these parameters in order to change the classification of their slaughterhouse and hence avoid falling into the category for which waterbaths are banned (e.g. one possible way of doing this may be to divide a large slaughterhouse into two smaller slaughterhouses).

### **Partial ban based on species**

Laying hens, being older birds, have brittle bones and a ban on the use of waterbath stunning systems for this species could be justified on animal welfare grounds. Additionally, laying hens are sometimes exported to other Member States using dedicated slaughterhouses which reduces the number of slaughterhouses likely to be affected by a ban. It is harder to shackle turkeys live due to their size and worker injuries are more likely. A ban on the use of waterbaths in this sector could therefore be justified on worker safety grounds. Such a partial ban would therefore offer positive **social** impacts in terms of additional animal welfare in the case of laying hens and in terms of worker welfare in the case of turkeys. These species account for relatively small proportions of overall poultry numbers and economic impact would be in proportion. However, there might be **technological** issues where these

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<sup>72</sup> Due to the differences between birds in terms of size, there are turkey CAS slaughterhouses with lower capacities than broiler slaughterhouses.

species are slaughtered in low capacity facilities. There may also be **social** issues if a ban on waterbath systems accelerated concentration in the industry and resulted in the closure of smaller slaughterhouses and consequent loss of employment. The closure of smaller slaughterhouses might also result in the increased transport of bird between farm and slaughterhouse with **environmental** impacts and **social** impacts in terms of animal welfare.

### **Partial ban based on slaughterhouse market**

There are two main ways of viewing a partial ban based on markets. First, whether the market is religious or not, and second, whether the market is for whole birds or portions.

In the case of **differentiation by religion**, recognising the widespread perception that CAS systems are not acceptable to many religious groups, a full or partial ban based on any of the approaches set out above could be introduced with an expanded religious derogation to allow waterbath stunning systems. In **political** terms this would respect the religious rites aspect of Article 13 of the TFEU while respecting the animal welfare aspects of Article 13 for the mass, non-religious market. Other impacts would generally be as outlined above, depending on whether a full or partial ban was introduced. A potential **legal** issue might arise in setting up a system to ensure that poultry slaughtered under the religious derogation did not enter the non-religious market. A traceability system would also need to be established which would imply an **economic** cost on one of the market segments. It would be most economically efficient to impose this on the smaller religious segment, but this might raise **political** concerns over discrimination and **social** concerns in terms of increased consumer prices (although increased consumer prices would be imposed on both market segments).

**Differentiation by end market** (whole bird or portions) might require a **political** explanation in terms of why animal welfare concerns form the basis of policy for some markets and not for others, as is the case with a partial ban by slaughterhouse size. In **legal** terms it should be noted that not all slaughterhouses also operate a cutting plant. These slaughterhouses simply supply whole birds to dedicated cutting plants who then serve the end market. This means that the policy would have no effect on systems used by these slaughterhouses unless a relationship were to be established between these slaughterhouses and cutting plants. As separate legal entities this might be problematic. In **economic** terms, and for slaughterhouses also operating a cutting plant, such an approach might change the supply dynamics of the market with slaughterhouses not wishing to convert concentrating on the whole bird market. This would result in lower prices in the whole bird market and higher prices in the portion market which would have **social** impacts on consumers (positive and negative respectively). **Technological** and **environmental** issues would be as outlined above under a full ban. A variant on a ban which **differentiates by end market** would be a ban which **differentiates by bird size**. The rationale would be that slaughterhouses which slaughter larger birds are more likely to serve the portion market. Such a ban would undoubtedly be easier to operate in practical terms. However, given that many slaughterhouses slaughter birds of different sizes and serve multiple markets, there may still be some difficulties with the practical implementation of such a policy.

### **Partial ban based on new slaughterhouses**

A ban on waterbath stunning systems could be introduced for new build slaughterhouses. The main advantage of such a phased approach would be **economic** in that existing slaughterhouses would not need to replace existing systems. That said, new slaughterhouses would be at a cost disadvantage to existing facilities and may not be able to recoup this from the market. However, a **political** case might need to be made for differential treatment. This would be necessary in terms of the rationale, i.e. if the rationale for a ban is to comply with EFSA's animal welfare opinion then a reason for not applying this to existing facilities would be needed. The other impacts set out under a complete ban would apply only to new slaughterhouses.

In order to progress from a partial to a full ban over time it would be necessary to prevent reinvestment in waterbath facilities. This could be instigated at the same time or with a transition period during which existing investment could be written off. Finally, given the relative simplicity of the waterbath system it might be necessary to set a date after which existing waterbath stunning systems could no longer be operated. At this point all the issues covered above would apply.

### **Combinations of the above**

Finally, it would be possible to introduce a partial ban based on various combinations of the above. For example, a partial ban based on new slaughterhouses over a certain capacity could be considered, with or without further differentiation by species and/or end market. The impacts of such an approach would combine the impacts set out above, but might also bring additional impacts such as providing an incentive for new slaughterhouses to have capacities below the cut off point to allow the use of waterbath systems. This would, for example, reduce the **social** impact in terms of improving animal welfare.

### **4.3.3. Summary**

Evidence suggests that a complete ban on waterbath system is, on balance, not feasible at this time. Various options were examined for a partial ban. These options were not without problems. On balance, a partial ban for new slaughterhouses appeared the most feasible option; this could also be in conjunction with other criteria such as slaughterhouse capacity, end market or species. Nonetheless, other issues would have to be examined prior to the introduction of such a partial ban, most notably how this partial ban would be transformed into a full ban over time.

### **4.4. Conclusion on options for phasing out waterbath stunning systems**

Although EFSA recommends the phasing out of waterbath systems on animal welfare grounds there are fundamental problems with enacting this in practice. First, commercial alternatives to waterbath systems are limited, especially for smaller-scale operators. Second, the only alternative system commercially available in the EU is relatively expensive to install and operate and is so far restricted to large-scale operations serving specific markets. Finally, consumer consume over animal welfare at slaughter is variable across the EU. Added to this the current legislative framework begins to take effect from January 2013, but will not be implemented fully until 2019. This will change the baseline across the EU. This appears likely to alter the relative operating costs which might prompt some

slaughterhouse operators to phase out their waterbath systems on a voluntary basis over the coming years as and when reinvestment is required.

However, the implementation of Regulation (EC) No 1099/09 also provides some disincentives for slaughterhouse operators to invest in alternative systems where investments have been made in the current system to ensure compliance. In such cases operators are likely to be resistant to further reinvestment within the working life of their current equipment.

Against this background it is unlikely that there will be a widespread voluntary phasing out of waterbath systems across the EU in the short to medium-term. The same issues mean that a mandatory and complete phasing out of waterbath systems would also be problematic. Various options for a partial phasing out of waterbath systems have been considered and while some of these options address, or partially address, certain concerns, they also raise other issues.

Even if the EU were to introduce a ban on waterbath stunning, the practice would remain prevalent in the rest of the world, and EU operators may be negatively impacted in terms of competitiveness on the world market. A few interviewees commented that both legislation and the public debate in recent years on waterbath stunning had discouraged work on improvements to the waterbath stunner, and that given the popularity of waterbath systems on a global scale, EU legislation should encourage both improvements to the waterbath stunner and alternatives rather than prohibit waterbath stunning.

Finally, the entry into force of the minimum parameters specified in Regulation (EC) No 1099/09 effectively addresses one of the problems of waterbath stunning, namely the collective experience which results in an inadequate stun. However, the problems of live shackling and inversion remain unaddressed.

Given the above, and the imminent entry into force of Regulation (EC) No 1099/99, it is **recommended that no further action be taken at this point in time**. The use of stunning systems should be monitored against the background of the Regulation over a period of three to five years in order to confirm the evolution of the use of systems and the development of further alternatives.

#### **4.5. Indicators for monitoring and evaluating the future situation**

The terms of reference request the inclusion of core progress indicators of a possible intervention. However, we do not feel that further intervention in this sector is appropriate at this time. We therefore focus on indicators for monitoring the evolution of the future situation under Regulation (EC) No 1099/09.

The impact assessment report accompanying the proposal for a Council Regulation on the protection of animals at the time of killing (European Commission, 2008) notes that general monitoring of the legislation on animal welfare is included in Regulation (EC) No 882/2004 on official controls of food and feed. However, what is required here is the gathering of specific information which will allow an assessment of changes in the use of stunning systems. While European Commission (2008) explains

that findings from Commission experts is the most reliable and specific source of information, there is also room to gather some basic data which would allow a more continuous appraisal of the situation at the EU level.

The first requirement is for a key **context indicator** to allow an understanding of the structure of the sector in terms of the number of poultry slaughterhouses, the stunning systems used and their throughput. To this end Member States should be requested to provide this information to the Commission in a standard format to allow summary statistics to be prepared using throughput categories (decided according to the data) to provide an indication of scale. These data should be collected annually so that changes in the use of systems and changes in throughputs can be identified. These data should be capable of providing information on the number of slaughterhouses using specific stunning systems and the number of birds, split by species, which are passing through these systems. This indicator should not be used to directly measure policy improvement, but rather to measure the current situation and the potential for policy change. With such data it would be possible to understand whether the use of waterbath systems is declining and also whether there are differences in any trend by throughput or Member State. The reasons for any differences could then be investigated (and through investigation it may be also possible to connect changes in system usage to policy itself).

If such a formalised system is deemed to be too much of a burden on Member States and slaughterhouse operators, consideration should be given to carrying out periodic surveys of slaughterhouse operating standards in line with the work carried out in the UK (FSA, 2012a). The FSA work consisted of a survey of approved slaughterhouses during a one week period completed by the FSA itself. The survey contained some 45 questions for poultry slaughterhouses. While the survey focussed primarily on compliance with legislation, it also covered some aspects of layout; and such an annual survey could indeed be extended to cover more precise layout aspects including slaughterhouse throughput, stunning system in use and age of the system.

The above will make clear the stunning systems in commercial use. However, it will not provide an indication of the development of other alternatives. A further **context indicator** would therefore be the near-commercial availability of alternative systems. This would be best established through periodic research carried out by Commission experts. In the case of the emergence of a near-commercial alternative system, and prior to any legislative changes, a comparison of the costs of these systems against existing commercial systems should be made for different size slaughterhouses.

Regulation (EC) No 1099/09 introduces a number of legal requirements and it can be assumed that the mechanisms in place to ensure that these are adhered to are sufficient to ensure compliance. There is therefore no need to provide additional monitoring in this respect.

However, one such requirement is the recording of stunning parameters used in electrical waterbath systems and it is possible to develop this requirement a little further into a **result indicator**. Consideration should be given to whether it is possible to require slaughterhouses to report the average

parameters used to either Member State Competent Authorities or the FVO who could then collate this information so that summary statistics on the parameters used by species can be collated. EFSA investigations into the effectiveness of stun at various parameters has already been undertaken (EFSA, 2012) and this, possibly in combination with further research, could be used to refine the combinations of current and frequency further to increase the proportion of birds which are adequately stunned.

A further **result indicator** should be the impact of different stunning parameters on product quality. It is noted that no consideration of impact on quality appears to have been made with respect to Regulation (EC) No 1099/09 and, as a result, there is little or no evidence in this regard. EFSA investigations into the effectiveness of stun obtained using different parameters should therefore include consideration of the impact on meat quality.

In preparation for the implementation of changes to slaughterhouse layouts from 2019 it would be useful to establish an inventory of slaughterhouses which will need to make alterations. This could be carried out alongside routine slaughterhouse visits and would provide an **output indicator** of progress towards compliance post-2019. Finally, in line with European Commission (2008), it would be useful to carry out a study similar in scope to this one after 2015 in order to assess any changes in the use of stunning systems and the development of alternative commercial systems, specifically for smaller-scale slaughterhouses.



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## **6. List of interviewees and organisations contacted**

Below is a list of interviewees and organisations contacted during the study. In addition to the organisations mentioned here, approximately 50 organisations were contacted or interviewed during the course of the Case Studies. Please see section 10 of the Case study annex for a full list of these national level interviewees. Please note that some of the findings of interviewees with national level interviewees have been incorporated directly into the final report. We are grateful to all organisations listed here and in section 10 of the Case study annex for their assistance during the course of the study.

### **Commission Services**

DG SANCO  
DG TRADE  
DG AGRI  
FVO

### **Stakeholders**

AVEC  
EFFAT (survey distributed to its members but replies not received)  
Eurogroup for Animals  
Humane Slaughter Association (HSA)  
McDonalds  
World Society for the Protection of Animals (WSPA)

### **Manufacturers and stunning system developers**

Anglia Autoflow  
Cattaruzzi  
Dutch Vision Solutions  
Linco  
Marel Stork  
Meyn  
Royal Veterinary College  
Silsoe Systems  
Topkip

### **Experts**

Dr Bert Lambooij, University of Wageningen  
Dr Dorothy McKeegan, University of Glasgow  
Dr Mohan Raj, University of Bristol

### **Third Countries**

Permanent Representation of Brazil to the EU  
Permanent Representation of Thailand to the EU / Thai Broiler Association  
US Poultry and Egg Council



## Appendix 1: Table of complete EU level policy baseline

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
<i>What changes?</i>		<i>The base regulation enters into force</i>	<i>The simplified procedure for certificates of competence (article 21) comes to an end.</i>	<i>The rules of article 14 (1) start to apply to all slaughterhouses, not just new ones.</i>
<b>Slaughter outwith slaughterhouses / for personal consumption</b>	Stunning requirement applies for slaughter outwith slaughterhouses. For personal consumption, the MS may provide derogations ( <i>article 9</i> )	Provisions do not apply to poultry slaughtered for private consumption ( <i>article 1 (3-b)</i> ). <i>Article 11:</i> Direct small supply of poultry must only fulfil some requirements, though these include the requirement of stunning.	<i>No change</i>	<i>No change</i>
<i>Changes</i>		<i>Private consumption now clearly excluded.</i>	<i>No change</i>	<i>No change</i>
<b>Third country</b>	Must be equivalent ( <i>article 15</i> )	The requirements of chapters II and III of the regulation must be fulfilled; an attestation must be provided ( <i>article 12</i> ).	<i>No change</i>	<i>No change</i>
<i>Changes</i>		<i>No significant changes.</i>	<i>No change</i>	<i>No change</i>
<b>Stunning methods permitted<sup>73</sup></b>	Captive bolt pistol Concussion Electronarcosis Exposure to CO2	<b>Mechanical:</b> penetrative and non-penetrative captive bolts; <i>firearm with free projectile; maceration; cervical dislocation, percussive blow to the</i>	<i>No change</i>	<i>No change</i>

<sup>73</sup> Note that the comparison method here focuses on stunning rather than stunning and killing. That said it is noted that there is some crossover between some of the methods mentioned here. Killing specific methods have been placed in italics and grey.



Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
	(Annex C, I)	head. <b>Electrical:</b> head only stunning, head to body stunning, waterbath. <b>Gas:</b> CO <sub>2</sub> ; CO <sub>2</sub> with associated inert gases; inert gases; carbon monoxide, carbon monoxide with other gases. (annex 1, chapter 1)		
<b>Changes in permitted methods</b>		Categories are more specific. Introduction of inert gases, carbon monoxide, and mixes.	No change	No change
<b>Captive bolt requirements</b>	Position to ensure the projectile enters cerebral cortex Must check the bolt retracts to its full extent after each shot Animals must not be placed in stunning pens or head restraints until the operator is ready to stun. (annex C, II, 1)	Non penetrative: must pay attention to avoid fracture of the skull. (annex 1, II)	No change	No change
<b>Concussion requirements</b>	Only through a mechanically operated instrument which administers a blow to the skull. Instrument must be properly used in order to produce an effective stun without fracturing the skull. (annex C, II, 2)			
<b>Changes in captive bolt / concussion</b>		Nothing significant (the ready criteria has been moved to general provisions).	No change	No change
<b>Electrodes requirements</b>	Must be placed so that they span the brain. Measures must be taken to	<b>Head only</b> (Annex 1 chap 2):		(Annex 2): rules here will apply to <u>all</u> slaughterhouses (new and

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
	<p>ensure good electrical contact.            For individual stunning, the apparatus must:</p> <ul style="list-style-type: none"> <li>• Incorporate a device which measure the impedance of the load and prevents operation if minimum current requirement cannot be passed</li> <li>• Incorporate an audible or visible device indicating the length of time of its application to an animal</li> <li>• Indicate the voltage and current under load so the operator can see this</li> </ul> <p>(annex C, II, 3a)</p>	<ul style="list-style-type: none"> <li>• must span the brain and be adapted to the animal's size.</li> <li>• Minimum current: 240mA for chickens (400 for turkeys)</li> </ul> <p><b>All electrical equipment except waterbath.</b>  <i>(Annex 2): rules here will apply to new slaughterhouses only</i></p> <ul style="list-style-type: none"> <li>• Equipment must have a device which displays and records key electrical parameters for each animal stunned. These must be clearly visible to personnel, and records must be kept for 1 year minimum.</li> <li>• Automated equipment with a restrainer shall deliver a constant current.</li> </ul>		<p><i>existing)</i></p> <ul style="list-style-type: none"> <li>• Equipment must have a device which displays and records key electrical parameters for each animal stunned. These must be clearly visible to personnel, and records must be kept for 1 year minimum.</li> <li>• Automated equipment with a restrainer shall deliver a constant current.</li> </ul>
<b>Changes in electrode / head only stunning</b>		<p><i>Specification of minimum currents</i>  <i>For new slaughterhouses: constant current requirement, recording of parameters.</i></p>	<i>No change</i>	<i>For all slaughterhouses: constant current requirement, recording of parameters.</i>
<b>Water bath requirements</b>	<ul style="list-style-type: none"> <li>• Level of water must be adjustable in order to ensure there is good contact with the birds head.</li> <li>• The strength and duration of the current will be determined by the CA in order to ensure the animal is immediately rendered unconscious</li> </ul>	<p><i>(Annex 1 chapt 2):</i></p> <ul style="list-style-type: none"> <li>• Animals must not be shackled if they are too small for stunner or if shackling is likely to increase pain suffered (e.g. when injured).</li> <li>• Shackles must be wet first.</li> </ul>	<i>No Change</i>	<p><i>(Annex 2): rules here will apply to <u>all</u> slaughterhouses (new and existing)</i></p> <ul style="list-style-type: none"> <li>• Designed and positioned so that birds are clear of obstruction and animal disturbance at a minimum.</li> </ul>

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
	<p>and remains so till death.</p> <ul style="list-style-type: none"> <li>For group stunning, the voltage must be sufficient to ensure every bird is stunned and remains stunned.</li> <li>Appropriate measures must be taken to ensure the current passes properly, including good electrical contacts and wetting the shackle to leg contacts.</li> <li>Baths must be an adequate size and depth for birds being slaughtered, and must not overflow at the entrance.</li> <li>The electrode in the water must extend the length of the waterbath.</li> <li>Manual back up must be available if necessary.</li> </ul> <p>(annex C, II, 3b)</p>	<p>Birds must be hung by both legs.</p> <ul style="list-style-type: none"> <li>Minimum currents: 100mA under 200hz; 150mA between 200 and 400 hz; 200mA between 400 and 1500hz.</li> </ul> <p>(Annex 2): rules here will apply to new slaughterhouses only</p> <ul style="list-style-type: none"> <li>Designed and positioned so that birds are clear of obstruction and animal disturbance at a minimum.</li> <li>Designed so that birds must not hang conscious for more than 1 minute (2 minutes for ducks, geese and turkey).</li> <li>The whole line up to the scald tank must be easily accessible so birds can be removed.</li> <li>Size and shape of shackles shall be appropriate for the size of the legs (so electrical contact can be secured without causing pain)</li> <li>An electrically insulated entry ramp must be installed, it must prevent overflow of water at the entrance.</li> <li>The level of immersion of the</li> </ul>		<ul style="list-style-type: none"> <li>Designed so that birds must not hang conscious for more than 1 minute (2 minutes for ducks, geese and turkey).</li> <li>The whole line up to the scald tank must be easily accessible so birds can be removed.</li> <li>Size and shape of shackles shall be appropriate for the size of the legs (so electrical contact can be secured without causing pain)</li> <li>An electrically insulated entry ramp must be installed, it must prevent overflow of water at the entrance.</li> <li>The level of immersion of the birds must be easily adaptable.</li> <li>Electrodes in the waterbath shall extend the length of the bath. Shackles should be in continuous contact with the earth rubbing bar as they pass over the water.</li> <li>A system in contact with the breast of the birds from the point of shackling till they</li> </ul>

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		birds must be easily adaptable. <ul style="list-style-type: none"> <li>Electrodes in the waterbath shall extend the length of the bath. Shackles should be in continuous contact with the earth rubbing bar as they pass over the water.</li> <li>A system in contact with the breast of the birds from the point of shackling till they enter the stunner to calm them.</li> <li>Access to the stunner will allow the bleeding of birds which have been stunned and are stuck in the waterbath following a breakdown.</li> <li>A device which displays and records the details of key parameters used must be fitted. Records shall be kept for 1 year.</li> </ul>		enter the stunner to calm them. <ul style="list-style-type: none"> <li>Access to the stunner will allow the bleeding of birds which have been stunned and are stuck in the waterbath following a breakdown.</li> <li>A device which displays and records the details of key parameters used must be fitted. Records shall be kept for 1 year.</li> </ul>
<b>Changes</b>		<ul style="list-style-type: none"> <li><i>Specification of minimum currents</i></li> <li><i>Birds not shackled if increases pain.</i></li> </ul> <i>For new slaughterhouses:</i> <ul style="list-style-type: none"> <li><i>Device displaying current and keeping of records</i></li> <li><i>The use of a system in contact</i></li> </ul>	<i>No Change</i>	<i>For all slaughterhouses:</i> <ul style="list-style-type: none"> <li><i>Device displaying current and keeping of records</i></li> <li><i>The use of a system in contact with the breast</i></li> <li><i>Maximum hang time 1 minute</i></li> <li><i>Various other small changes</i></li> </ul>

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		<i>with the breast</i> <ul style="list-style-type: none"> <li>Maximum hang time 1 minute</li> <li>Various other small changes and precisions regarding the installations</li> </ul>		<i>and precisions regarding the installations</i>
<b>Gas requirements</b>	<b>CO2:</b> Specific requirements in the legislation are only applicable for pigs. <i>(annex C, II, 4)</i>	<i>(Annex 1 chapt 2):</i> <b>CO2:</b> Specific requirements are only for pigs. <b>CO2, inert gases and combinations:</b> Gases shall not enter the chamber in a way that could create burns or excitement by freezing or lack of humidity. <b>Carbon monoxide:</b> Animals must be kept under supervisions at all times. They shall be introduced one by one, and the previous animal must be unconscious or dead when the next is introduced <sup>74</sup> . <i>(Annex 2): rules here will apply to new slaughterhouses only</i> <ul style="list-style-type: none"> <li>Equipment must be designed and built to optimise stunning by gas, prevent injury and</li> </ul>	<i>No change</i>	<i>(Annex 2): rules here will apply to <u>all</u> slaughterhouses (new and existing)</i> <ul style="list-style-type: none"> <li>Equipment must be designed and built to optimise stunning by gas, prevent injury and contusions, and minimise struggle</li> <li>The gas stunner must measure, display and record continuously the gas concentration and time of exposure. Personnel must be able to see this. If the concentration falls below a certain level, there must be a visible and audible warning. Records must be kept for 1 year.</li> <li>Even at permitted throughput animals are able to lie down without being stacked on</li> </ul>

<sup>74</sup> The provisions here imply that carbon monoxide is only for use with larger mammals, however in Annex 1 of the regulation, it is stated that carbon monoxide can be used with poultry.

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		<p>contusions, and minimise struggle</p> <ul style="list-style-type: none"> <li>The gas stunner must measure, display and record continuously the gas concentration and time of exposure. Personnel must be able to see this. If the concentration falls below a certain level, there must be a visible and audible warning. Records must be kept for 1 year.</li> <li>Even at permitted throughput animals are able to lie down without being stacked on each other.</li> </ul>		each other.
<i>Changes</i>		<p><i>Entry of gas into chamber for CO<sub>2</sub>, inert gases and combinations.</i></p> <p><i>General design rules for gas stunning systems in <u>new</u> slaughterhouses</i></p> <p><i>Measurement and record rules for <u>new</u> slaughterhouses.</i></p>	<i>No change</i>	<p><i>General design rules for gas stunning systems in <u>all</u> slaughterhouses</i></p> <p><i>Measurement and record rules for <u>all</u> slaughterhouses.</i></p>
<b>Cross cutting requirements for the stunning process, use of equipment and slaughterhouse layout</b>	Instruments, equipment and installations used for stunning and killing must be designed, constructed, maintained and used in such a way as to achieve the rapid and effective stunning or killing of animals in accordance with the directive.	<p><i>Article 3:</i></p> <p>Facilities must be designed, constructed, operated and maintained to fulfil the animal welfare requirements mentioned in the article.</p> <p><i>Article 9:</i></p>	No change	<u>All</u> slaughterhouses must comply ensure restraining equipment optimises application of the stunning, prevent injury, and minimise struggle and time of restraint.

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
	(article 6)	<p>Animals must not be placed in stunning equipment until the operation is ready to stun or bleed them as quickly as possible.</p> <p>Backup equipment must be available.</p> <p>Equipment must be maintained and checked in accordance with manufacturer instructions.</p> <p><i>Annex II / Article 14:</i></p> <ul style="list-style-type: none"> <li>• When requested, slaughterhouses must provide information on the maximum number of animals per hour, weights and lairage capacity. This applies to existing and new slaughterhouses.</li> <li>• <u>New</u> slaughterhouses (entering into operation after 1/1/2013) must comply ensure restraining equipment optimises application of the stunning, prevent injury, and minimise struggle and time of restraint.</li> </ul> <p><i>Article 15; Annex III<sup>75</sup>;</i></p> <p>A steady supply of animals for stunning shall be ensured to prevent</p>		

<sup>75</sup> There are various other requirements but none of these relate specifically to stunning.



Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		handlers rushing animals from handling pens.		
<b>Changes</b>		<p><i>Animals placed in equipment only when ready for all stunning methods<sup>76</sup>. Equipment must be maintained.</i></p> <p><i>Information on slaughterhouse capacities available on request.</i></p> <p><i>Some general design issues for <u>new</u> slaughterhouses.</i></p> <p><i>A steady supply of animals for stunning must be available.</i></p>	<i>No change</i>	<i>Some general design issues for <u>all</u> slaughterhouses.</i>
<b>Religious slaughter</b>	<p><i>Article 5</i></p> <p>In the case of animals subject to particular methods of slaughter required by certain religious rites, stunning requirements (article 1(c)) shall not apply.</p>	<p><i>Article 4 (4):</i></p> <p>For animals subject to slaughter prescribed by religious rights, the stunning requirements (article 4(1)) will not apply provided slaughter takes place in a slaughterhouse.</p>	<i>No change</i>	<i>No change</i>
<b>Changes</b>		<b><i>Effectively the same</i></b>	<b><i>No change</i></b>	<b><i>No change</i></b>
<b>Checks on stunning and monitoring by slaughterhouse; other slaughterhouse obligations</b>	None foreseen.	<p><i>Article 5;</i> operators must ensure that staff carry out regular checks to ensure that animals do not present any signs of consciousness.</p> <p>Checks must be carried out on a representative sample of animals, with frequency established based on</p>	<i>No change</i>	<i>No change</i>

<sup>76</sup> This was previously only explicitly stated for captive bolt stunning.

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		<p>the outcome of previous checks. If animals are not properly stunned, appropriate measures as defined in standard operating procedures will be taken.</p> <p>For animals killed through religious slaughter without prior stunning, there will be checks on consciousness and signs of life at different stages. (<i>paragraph 2</i>)</p> <p>Derogations from checks possible for methods considered highly reliable based on an EFSA opinion (<i>paragraph 4</i>)</p> <p><i>Article 16</i></p> <p>A monitoring procedure shall be set up; this will describe how the checks in article 5 are performed.</p> <p><i>Article 17:</i></p> <p>Business shall designate an animal welfare office to assist in ensuring compliance with the regulation<sup>77</sup>.</p>		
<b>Changes</b>		<p><i>Introduction of self checking obligation based on a monitoring plan.</i></p> <p><i>Introduction of an animal welfare officer.</i></p>	<i>No change</i>	<i>No change</i>

<sup>77</sup> See Article 17 for a list of tasks of the officer.

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
<b>Certification of staff</b>	<p><i>Article 7:</i>                      No person can be involved unless they have the necessary knowledge and skills.                      The competent authority shall ensure that the persons involved have the necessary skill, ability and knowledge.</p>	<p><i>Article 7</i>                      Operations will be carried out by staff with a suitable level of competence.                      Staff involved in restraint, shackling, stunning and assessment of stunning must hold a certificate of competence (article 21<sup>78</sup>), though this certificate may be issued by means of a fast track procedure (i.e. if the employee has 3 years working experience)</p>	<p><i>Article 29 (2)</i>                      End of fast track certification, full certification required in accordance with the requirements of article 21.</p>	
<b>Changes</b>		<i>Introduction of certificates of competence, though 3 years experience sufficient to obtain one.</i>	<i>Introduction of full requirements for certificates of competence.</i>	<i>No change</i>
<b>General operating procedures,</b>	No specific provisions.	<p><i>Articles 6;</i></p> <ul style="list-style-type: none"> <li>Operators shall draw up and implement standard operating procedures to ensure killing related operations are carried out in accordance with general requirements.</li> <li>For stunning, this will take into account: manufacturer recommendations, definition of key parameters as listed in</li> </ul>	<i>No change</i>	<i>No change</i>

<sup>78</sup> Please see Article 21; a variety of criteria, but none of them relate specifically to stunning (though they obviously have indirect relevance). This is more a staff training issue and not a stunning method / equipment issue. Until 2015, the certification procedure is fast track as mentioned.

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		annex 1 of the regulation; specify the measures to be taken when an animal is found as not stunned following checks.		
<i>Changes</i>		<i>The introduction of Standard operating procedures for operators</i>	<i>No change</i>	<i>No change</i>
<b>Instructions (manufacturer issue)</b>	No specific provisions.	<p>Article 8;            Machines must come with instructions which specify:</p> <ul style="list-style-type: none"> <li>• Specific categories of animals, weight and numbers</li> <li>• Recommended parameters for the stunning method (as defined in annex 1 of the regulation)</li> <li>• Recommended maintenance schedule</li> </ul>		
<i>Changes</i>		<i>The introduction of the requirement for the manufacturer to provide instructions and recommendations.</i>	<i>No change</i>	<i>No change</i>
<b>Other Member state and CA obligations</b>	<p>Article 8            Inspections and controls to ensure compliance with the directive shall be carried out under the responsibility of the CA.</p> <p>Article 14            Commission experts may make on the spot checks.</p>	<p>Article 13:            Member states shall encourage the development and distribution of guides of good practice by organisations of operators, and where the organisations fail to provide this, may develop their own guides.</p> <p>Article 20:</p>		

Requirement	Now (93/119)	1/1/2013 (introduction of 1099/2009)	8/12/15	8/12/19
		Scientific support must be available to assist CAs.		
<i>Changes</i>		<i>The emphasis of inspections and controls moved to the operator. Member States / CAs encouraged to provide support through guides of good practice and scientific support.</i>	<i>No change</i>	<i>No change</i>

## Appendix 2: Competent Authority survey results

The Competent Authority survey was launched at the end of March 2012. 17 complete answers to the survey have been received. The key findings of the survey are presented here, on a per question basis. Please note that not all of the replies to the questions are presented here, given that some of the questions relate to practical aspects.

### *Q7: Are slaughterhouse workers legally required to hold any qualifications at present?*

MS	No	Yes	Details
AT		X	slaughterhouse staff for meat inspection (Reg.853) acc. animal welfare (Dir. 93/119)
BE		X	For the workers that need a qualification in the framework of the assisted expertise of poultry meat, or in the framework of self-control.
BG	X		
CZ		X	The qualifications of workers is determined in the Act No. 246/1992 and Degree No. 382/2004.
DE		X	1. Certificate including requirements for stunning and slaughter of poultry (§ 4 TierSchlV) 2. Instruction on infection control by the health department in dealing with poultry (§ 43 IfSG)
DK		X	Slaughterhouse workers must have sufficient knowledge and necessary skills to perform the work in a humane and effective way in accordance with legislation.
EE		X	
ES	X		
FI	X		
FR		X	Under Article 10 of the Order of 12 December 1997 on immobilization methods, stunning and killing of animals and animal welfare conditions in slaughterhouses, all personnel working at the slaughterhouse who have contact with live animals must be trained in general animal welfare.
HU	X		
IE		X	Slaughtermen must be licensed. Welfare officers must be formally trained On-site training is required for all workers, relevant to their work
LV		X	The certificate of training
NL	X		
PL		X	According to regulation of Ministry of Agriculture of 9 September 2004 on qualification of persons authorised to professional slaughter, conditions and methods of slaughter and killing animals: - theoretical training - 3 months of practices supervised by person having 3 years of working experience as a slaughterman and approved by district veterinary officer
SE		X	If by "slaughterhouse workers" OVS are not meant- EC 852/2004 and 43/2007 (in SJVFS 2010:15)
SK		X	According to Article 37 par. 2 letter e) of the Act No 39/2007 Coll on Veterinary Care as amended anybody dealing with animals (relating to protection of animals) is obliged to educate demonstrably the persons handling the animals to abstain from any act that might cause injury or any other damage to animal health or their unnecessary suffering. According to Article 7 par. 1,2 of the Ordinance of the Government of the Slovak Republic No 315/2003 Coll on the protection of animals at the time of slaughter or killing

			No person shall engage in the movement, lairaging, restraint, stunning, slaughter or killing of animals unless he has the knowledge and skill necessary to perform the tasks humanely and efficiently, in accordance with the requirements of this Directive. The competent authority shall ensure that persons employed for slaughtering possess the necessary skill, ability and professional knowledge.
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**Q8: Please estimate the market shares in percent (%) for the largest 8 broiler slaughterhouses in your Member State.**

MS	Slaughterhouse ranking									
	1	2	3	4	5	6	7	8	1-4	5-8
AT									<b>90</b>	<b>5</b>
BE	21	19	16	12	9	8	8	7		
BG										
CZ	25	24	19	7	6	6	6	3	<b>75</b>	<b>21</b>
DE	18	18	14	9.5	8	6	6	6	<b>59.5</b>	<b>26</b>
DK	40	25	23	8					<b>96</b>	<b>4</b>
EE	100								<b>100</b>	
ES	5.85	4.99	4.43	4.31	3.97	3.68	3.56	3.28	<b>19.58</b>	<b>14.49</b>
FI	50	35	15						<b>100</b>	
FR										
HU	20	12	10	10	9	5	4	3	<b>52</b>	<b>21</b>
IE										
LV	62	38								
NL	13	12	10	10	9	8	6	6	<b>45</b>	<b>29</b>
PL										
SE										
SK									<b>85</b>	<b>15</b>

Note that following the request of several Member States who were either unable to answer this question, or unwilling to provide industry data, this question had to be made non-obligatory.

**Q9: Approximately what proportion of total slaughtering (throughput) is accounted for by Controlled Atmosphere Stunning in your Member State?**

MS	Broilers	End of lay hens	Parent stock	Turkeys	Turkey parent stock	Comments
AT	65%					
BE	5%	5%		0%		Broilers: 4,2 %, End of lay hens: 2,1%
BG	0%	0%	0%	0%	0%	
CZ	0%	0%	0%	0%	0%	We do not use Controlled Atmosphere Stunning at any slaughterhouses.
DE	60%			40%		Gas stunning only allowed under derogation.
DK	0%	0%	0%	0%	0%	End of lay hens are not slaughtered but killed by CO2 gas in a mobile system used for feed production for fur animals
EE	0%	0%	0%			



ES	3.13%					There are two slaughterhouses with CAS for turkeys and their parent stock but it is not possible to estimate their market share.
FI	85%	0%	0%	0%	0%	
FR	5%	5%		5%		5 % of all poultry is gas stunned.
HU	0%	0%	0%	0%	0%	
IE	0%	0%	0%	0%	0%	
LV	0%					
NL	25%	60%	60%	0%	0%	It is not possible to differentiate between poultry and end of lay hens in statistics.
PL	0%	0%	0%	0%	0%	
SE	30%					In one slaughterhouse
SK	0%	0%	0%	0%	0%	N/A

**Q10: If Controlled Atmosphere Stunning is used in your Member State, please explain which gas mixtures are used.**

MS	Biphasic CO2	Monophasic CO2	Inert gas mix	Other	Comments
AT	X				
BE	X				
DE	X		X		Some argon used, but ministry does not have details.
ES	X				
FI	X				
FR	X	X			
NL	X				4 Slaughterhouses use CAS 1st phase during at least 1 min CO2 30-40%, O2 25-30%, 2nd phase during at least 2 minutes CO2 at least 70%
SE	X				

**Q11: What are the reasons for the use of gas mixtures indicated in the question above?**

MS	Legislative	Cost	Other	Comments
AT			X	Decision of plant owner
BE	X			
DE			X	Some argon used, but ministry does not have details.
ES			X	Better management and better animal welfare.
FI	X			
FR		X		
NL	X	X	X	We don't know why slaughterhouses choose CAS or waterbath stunning. Slaughterhouse may choose a mixture but has to produce scientific proof it works, if a new mixture is proposed. One company wanted to use a different concentration in both phases. They were required to produce scientific evidence. Availability of the used gases and systems and environmental legislation on the storage of these

				gases (local council legislation) influences their choice as well.
SE	X		X	Animal welfare reasons (no shackling of conscious animals): easier and quicker flow

**Q12: What is driving the conversion from multiple-bird waterbath stunning?**

MS	No conversion	in Paramaters Regulation (EC) No 1099/2009	Costs	Product quality	Revenue	Retailer / food service industry pressure	Consumer demands	Employment considerations	Environment	Other	Reasons
AT				X				X	X		GMP less wastewater
BE		X		X							
BG	X										
CZ	X										
DE				X	X		X	X		X	Animal welfare, surer stunning, avoidance of meat damage, fewer workers.
DK	X										
EE											
ES	X										
FI	X										
FR	X										Little gas conversion because of cost.
HU											
IE						X					
LV			X	X					X		
NL		X		X						X	Political/social pressure to move away from waterbath stunning. also the work environment rules are helping (dust in air).
PL	X										
SE	X									X	No real "conversion" as only in one slaughterhouse.
SK	X										

**Q13: What are the main barriers to the use of Controlled Atmosphere Stunning in your Member State? Select as many as relevant.**

MS	High investment costs	Insufficient capital for investment	Space issues for installation	Planning requirements	No market premium for CAS meat	No / limited cost savings	Lack of experience with CAS	Other	Reasons
AT	X								
BE	X	X	X		X	X		X	Substantial higher operational costs More susceptible to technical failure CAS is irreversible, so not conform with many ritual slaughtering rules
BG	X	X			X	X	X		
CZ		X		X	X				
DE	X						X	X	Investment costs a particular problem for small companies. Physiological impacts for ducks.
DK	X				X			X	Halal requirements
EE									
ES	X	X	X		X		X		
FI	X								
FR	X	X	X	X	X	X	X		
HU	X	X	X						
IE	X								
LV	X							X	Low national production volumes.
NL	X		X	X				X	Some slaughterhouses are small --> waterbath is cheap to operate. Higher operating costs. Sometimes the space is just not there and expanding is not always an option. Some local councils are very much against the storage of the gases. Some halal organisations don't allow the using of CAS
PL									
SE									
SK	X	X	X				X		

**Q14: Are you aware of the development of any alternative to multiple-bird waterbath and Controlled Atmosphere Stunning systems in your Member State?**

**Yes:** 3 Member States (DE, NL, SE).

**Q16 and 17: Are minimum currents for stunning specified in existing legislation? Are there any provisions in national legislation which go beyond what is specified in Directive 93/119/EC?**

Minimum currents			Additional provisions	
MS	Y/N	Details	Y/N	Details
AT	Y	broiler/hen 0,1 Ampere 4sec turkey 0,15 Ampere 4sec duck, goose 0,13 Ampere 6sec quail 0,06 Ampere 4sec	N	
BE	N		N	
BG	Y	Broilers (1,5kg - 2kg) - 120 mA; End of lay hens - 120 mA; Turkey - 150 mA	N	
CZ	Y	50 Hz, 4 sec, 120 mA - broilers, laying hens 50 Hz, 4 sec, 150 mA - turkey 50 Hz, 4 sec, 130 mA - geese and ducks	Y	Frequency
DE	Y	See Tierschutz-Schlachtverordnung.	Y	Durations
DK	N	The strength and duration of the current will in this case and in accordance with Directive 93/119/EC be determined by the competent authority so as to ensure, that the animal is immediately rendered unconscious and remains so until death.	N	
EE	Y	When birds are stunned with 50 Hz AC power, it is recommended that the current strength for broiler chickens is 120 mA, 150 mA for turkeys, 130 mA for geese and ducks and 50 mA for quail.	Y	Frequency
ES	N		N	
FI	Y	Yes, but only recommendations. 50 Hz sinusoidal alternating current and minimum current for end lay hens and broilers 120 mA and turkeys 150 mA.	Y	Frequency recommendations
FR	N		N	
HU	N	Hungary has a guideline which covers the recommendations of the relevant EFSA report.	N	
IE	N		N	
LV	Y	Broilers -0,24 amps.	Y	Paragraph 40. Stunning of animals in accordance with the provisions of paragraph 39 provides that the power voltage, current exposure time and other criteria are stunning equipment manufacturer's specified criteria.
NL	Y	The table as presented in 1099/2009 is already implemented in Dutch legislation (starting autumn 2009) mA as well as frequencies. However there are 2	Y	Frequencies. See previous comment

		exemptions: 1. broilers 200-400 Hz at least 100mA (until later this year, than it will be brought to 150 mA) 2. ducks 200-400 Hz at least 140mA is allowed until 1-1-2013.		
PL	Y	a) 0,15 A /4 sec - turkey, b) 0,13 A /6 sec - duck and geese c) 0,12 A / 4 sec - hens and broilers d) 0,06 A / 4 sec - quails	N	
SE	Y	Broiler, layer (Hz,mA): 50-200, 120 201-400, 120 401-1500, 150 Turkey 50-200, 150 201-400, 250 401-1500, 250	Y	Frequencies
SK	Y	Broilers, hens 160 mA per bird during 10 seconds	N	

**Q18 and 19: Where is your Member State with regards to the implementation of Regulation (EC) No 1099/2009? With regard specifically to the stunning of poultry, are there plans to introduce any regional/national measures which go beyond the EU legislation in the future?**

MS	Implementation Status				Future plans	
	Legislation in place	legislation drafted	Legislation in drafting	No progress	Y/N	Comments
AT			X		N	
BE			X		N	
BG				X	N	
CZ		X			Y	
DE		X			Y	There is the intention to use article 26 of the regulation to keep parts of the existing TierschlV which are stricter than the regulation.
DK			X		Y	The issue is in the process of being decided.
EE		X			N	
ES				X	N	
FI			X		N	
FR			X		N	
HU			X		N	Hungary is planning to have a new guideline.
IE				X	N	
LV		X			Y	Publication of regional press; press release public website; CA meetings with representatives of slaughterhouses; meetings with representatives of the Association of meat producers; good practice paper's developing; training of

						operators
NL			X		N	However the Minister of agriculture and the stakeholders have the intention of replacing waterbath stunning in the near future by different systems with individual application (instead of group application). See Q14.
PL			X		N	
SE		X			N	No plans or discussions at the present. However the authority is open to the idea.
SK			X		N	

**Q20: What sort of impacts are expected from the application of minimum currents for multiple-bird waterbath stunning which will be introduced in 2013 (1=v negative; 5= v positive).**

MS	Social	Economic	Environmental	Comments
AT	3	3	3	
BE	3	1	3	It seems the higher parameters for amperage will have a negative effect on carcass quality.
BG				
CZ	4	3	3	
DE	3	3	3	
DK	3	3	3	The possibility of introducing national legislation, cf. article 26 in Directive 1099/2009, is still being considered. It is therefore, for the time being, difficult to estimate the impacts from the application of minimum currents.
EE	3	3	3	
ES	2	1	3	Taking into account the social impact includes the possible loss of jobs and closing of slaughterhouses and perception of the consumer, it is considered there will be negative social impacts Due to the nature of poultry in Spain, it is expected that the new currents will negatively impact operators.
FI	3	3	3	
FR	3	2	3	Fear about quality problems due to blood in carcasses.
HU	3	3	3	
IE	4	3	3	Improvements in stunning techniques will have positive animal welfare effects
LV	3	3	3	
NL	4	2	3	Social: especially on AW which is a hot topic politically. Economic: most slaughterhouses are fearing the introduction of 200-400Hz 150 mA because currently they can use 100mA in that frequency range. Halal organisations are not happy with the higher mAs and also SH claim to have more

				spot bleeding in the meat.
PL	2	2		According the information from industry
SE	3	3	3	
SK	3	3	3	

**Q21 and 22: What sort of impacts are expected from the application of slaughterhouse layout requirements in Annex 2 of Regulation (EC) No 1099/2009? (1=v negative; 5= v positive). How difficult will it be for existing slaughterhouses in your Member State to comply with the layout provisions in annex 2 by the 2019 deadline? (1=v. difficult, 5= v. easy).**

MS	Social	Economic	Environmental	Comments	Difficult to conform
AT	3	3	3		4
BE	3	2	3		2
BG					
CZ	4	2	3		2
DE	3	3	3	Due to existing legislation, equipment should already conform with the requirements.	4
DK	3	2	3	It is estimated that minor investments are needed.	5
EE	3	3	3		4
ES	4	2	3	The structural modifications will require investment from the sector.	2
FI	3	3	3		3
FR	3	3	3	During the negotiation of the regulation, the two points which appeared problematic were: recording of parameters (point 5.10), and a limit on the time birds can hang (point 5.2).	3
HU	3	3	3		3
IE	2	2	2		4
LV	3	2	3		2
NL	3	3	3	For most poultry SH Annex 2 is not a large problem.	4
PL	4	2	3		
SE	3	3	3	Sweden already had stricter national regulation.	4
SK	3	3	3		3

**Q23: Has any research, (e.g. Impact Assessment) been completed in your Member State by the government, agencies, stakeholders or academics on the costs of complying with Regulation (EC) No 1099/2009?**

**Yes:** DE (contributions to the EU I.A. for the regulation); HU (for pigs only).

**Q24: Has any research been done by government affiliated agencies in your Member State with regards to the economic, social and/or environmental costs of different stunning systems?**



**Yes:** FI (CAS stunning of turkeys in small scale slaughterhouses as government funded research); NL (RIVM study).

## Appendix 3: Survey of slaughterhouses

### Background to the survey

The slaughterhouse survey was launched in June, 2012 and remained open until September 30, 2012. The questionnaire was discussed with AVEC and approved for use by the Steering Group following some small amendments for which we are grateful. The survey was promoted and co-ordinated through national AVEC members (whose help we also acknowledge). The survey was available both as a Word document (which could be completed and returned to the national AVEC member) and online. The Word version of the survey was available in English, French, Spanish and Italian. In total, some 52 replies were received, though five were deemed unusable<sup>79</sup>, leaving 47 usable replies.

It is important to note that, in order to facilitate a good rate of response, no questions in the survey were obligatory and the completeness of survey replies therefore varies. Approximately two-thirds of the 47 replies are almost complete (with only one or two questions left unanswered); the remainder are only partially complete. Furthermore, response rates for certain questions were notably higher than those for other questions. In view of this, it is necessary to contextualise statistics based on response rates to individual questions.

### Overview of the respondents

Replies were received from ten Member States, including seven of the nine case study countries. The UK and Italy were responsible for approximately a fifth of total responses each as shown below.

Member State	Number of replies	Proportion of total
BE	5	11%
DE	2	4%
ES	1	2%
FI	2	4%
FR	5	11%
HU	7	15%
IT	9	19%
NL	2	4%
SE	4	9%
UK	10	21%
Total	47	100%

In terms of **species**, the majority (36) of slaughterhouses which replied to the survey slaughter only broilers, reflecting the predominance of broilers within the wider poultry industry. A full breakdown of responses by species is presented in the table below. Some seven slaughterhouses slaughter more than one species of bird; one of these slaughters all five species, while the other six slaughter two or

<sup>79</sup> Three because the slaughterhouses dealt only with ducks and geese; two because there were no usable answers.

three species<sup>80</sup>. While specialisation in the slaughter of broilers or turkeys was common, only two respondent slaughterhouses specialise in laying hens and none in parent stock or turkey parent stock.

Species	Number of slaughterhouses
Broilers	36
Laying hens	7
Parent stock	3
Turkeys	12
Turkey parent stock	2
<b>Total number of slaughterhouses*</b>	<b>47</b>

\* The sum of individual of slaughterhouses is greater than the total presented due to some slaughterhouses handling more than one species, as explained in the text above.

The **throughput** of the slaughterhouses ranged from 250 birds per hour up to 25,500 birds per hour (which, though not indicated in the survey response, is believed to involve two processing lines). The average throughput of respondents was 7,805 birds per hour<sup>81</sup>. This fairly high average is likely to be a function of (a) AVEC involvement in distributing the survey with larger slaughterhouses well represented by AVEC; and, (b) the resources available within a slaughterhouse to provide a response. Broiler slaughterhouses replying to the survey tended to be larger than slaughterhouses of other species.

Size category (birds per hour)	All	Broilers	Laying hens	Parent stock	Turkey	Turkey parent stock
<b>Under 1,000</b>	<b>6</b>	3			3	1
<b>1,000-2,999</b>	<b>6</b>	2	2	1	6	1
<b>3,000-5,999</b>	<b>3</b>	2	1	1	1	
<b>6,000-8,999</b>	<b>13</b>	11	3	1		
<b>9,000-11,999</b>	<b>10</b>	9	1		2	
<b>Over 12,000</b>	<b>9</b>	9				

### Stunning systems

In terms of **stunning system** used, 36 (77%) of the respondent slaughterhouses use multiple-bird waterbath stunning systems and eight (17%) use a CAS system. Two have both CAS and waterbath systems installed. One slaughterhouse described its stunning system as “other”, without providing any further details. Given the low throughput of this slaughterhouse (250 birds per hour), it is most likely to use a form of manual slaughter which may or may not involve a small-scale stunning method<sup>82</sup>.

<sup>80</sup> It is important to note that where a slaughterhouse slaughters more than one species including broilers, it was assumed that the primary species slaughtered was broilers. Where broilers are not slaughtered the main species was assumed to be turkeys and if neither broilers nor turkeys are slaughtered the main species was assumed to be laying hens. This point is important for statistics presented by species later in this report.

<sup>81</sup> Counting the slaughterhouse with 25,500 birds per hour as two lines of 12,750.

<sup>82</sup> Some survey results are presented by stunning system later in this report with those slaughterhouses using two systems and the unidentified system omitted unless otherwise stated.

Six of the slaughterhouses using CAS slaughter broilers and two turkeys. The **average throughput** of slaughterhouses using CAS was higher than that of slaughterhouses using waterbaths.

	All species	Broilers
	Birds slaughtered per hour	
CAS	10,975	9,925
Waterbath	6,878	7,928

The **current stunning equipment** was installed between 1985 and 2011 with **waterbath** equipment in place for an average of 11 years (range 1 year to 27 years) and **CAS** systems in place for an average of six years (range 1 year to 11 years).

There was also a substantial difference in terms of the **average age of equipment by slaughterhouse size** as can be seen in the table below, with very small slaughterhouses tending to have older equipment and the largest slaughterhouses having newer equipment.

Size category	Average year of installation	Average age of equipment	Number of slaughterhouses
Under 1,000	1995	17	6
1,000-2,999	2005	7	6
3,000-5,999	2005	7	3
6,000-8,999	2000/2001	11-12	13
9,000-11,999	2003	9	10
Over 12,000	2004/2005	7/8	9

### Waterbath stunning parameters

Some 32 respondents provided at least partial data on the **waterbath parameters in use** in their slaughterhouse. Between 23 and 25 of these replies were from slaughterhouses considered to primarily be slaughtering broilers; between four and five from slaughterhouses primarily slaughtering turkeys; and two from slaughterhouses primarily slaughtering laying hens<sup>83</sup>. Data on the parameters in use are presented in the table below.

Parameter / Species	Broilers	Turkeys	Laying hens
Current minimum	20 mA	87 mA	20 mA
Current maximum	270 mA* (225 mA)	230 mA	150 mA
<b>Current average</b>	<b>109 mA (101 mA)</b>	<b>173 mA</b>	<b>85 mA</b>
Frequency minimum	50 hz	50 hz	50 hz
Frequency maximum	1,500 hz	320 hz	50 hz
<b>Frequency average</b>	<b>370 hz</b>	<b>169 hz</b>	<b>50 hz</b>
Duration minimum	5 secs	17 secs	4 secs
Duration maximum	30 secs	26 secs	8 secs
<b>Duration average</b>	<b>12.75 secs</b>	<b>22 secs</b>	<b>6 secs</b>
Voltage minimum	2v* (30v)	135	26.5v
Voltage maximum	210v	215v	140v
<b>Voltage average</b>	<b>92v (96v)</b>	<b>137v</b>	<b>138v</b>

<sup>83</sup> Ranges defined as not all slaughterhouses provided all parameters for electrical waterbath stunning.

<b>Waveform AC</b>	<b>74%**</b>	<b>100%</b>	<b>50%</b>
<b>Waveform DC</b>	<b>22%**</b>	<b>0</b>	<b>50%</b>

\* Please note that while these answers were provided, in the opinion of Agra CEAS, they are unlikely to be the actual parameters in use. Given the survey is anonymous for reasons of confidentiality, it has not been possible to re-confirm these parameters. Excluding these parameters will result in a smaller range (indicated in brackets) and will also slightly impact the average (also indicated in brackets).

\*\* One slaughterhouse used both AC and DC and is excluded from the table.

The average parameters for all species are below those that will be required under Regulation (EC) No 1099/09, but in all cases comply with relevant national legislation.

### **Regulation and cost of compliance**

There is a high **level of awareness of the Regulation** with four-fifths of respondents (39, 83%) indicating that they know it is coming into effect from January, 2013. However, four respondents (9%) stated that they were not aware of the Regulation. The remainder did not provide an answer.

The 39 respondents who were aware of the Regulation were asked what **level of modification will be required** to achieve compliance:

- 18% believed a new stunning system would be required;
- 23% indicated that major modifications to their slaughterhouse would be required. These responses were broken down as follows:
  - 15% believed major modifications would be required to achieve compliance;
  - 8% did not indicate the level of modifications required, but did estimate the cost of compliance and on this basis it is considered that the modifications required are major;
- 23% believed minor modifications only would be required; and,
- 33% believed that their system already complied and no modification would be required.

Some 69% of respondents with waterbath systems believed that some level of modification would be required and all those respondents who indicated that either a new stunning system or major modifications would be required operate waterbath systems. In contrast, 50% of respondents with CAS systems stated that only minor modifications would be required, while 50% said that their system was already compliant with the Regulation.

The actual **estimated cost of compliance for each degree of modification** is presented in the table below.

<b>Modifications required</b>	<b>Average estimated cost</b>	<b>Average age of system</b>
None	N/A	6-7 years
Minor	€11,786	8-9 years
Major	€41,667	14-15 years
New system	€944,500	18 years
Not indicated – considered major based on cost estimation	€37,500	(8 years)

Just over half (20 of the 39 respondents) aware of the Regulation **expressed concerns** about it. This included two respondents who use CAS systems. These concerns can be broken down as follows<sup>84</sup>:

- **Concerns with quality:** 13 mentions.
- **Concerns with a perceived push towards CAS** (respondents felt that under the Regulation they will have to install a CAS system due to quality issues, but noted that they would experience several problems with making this change): 4 mentions.
- **Concerns with animal welfare**, including that the parameters will result in a high incidence of cardiac arrest: 3 mentions.
- **Other concerns:** 1 mention each (incompatibility with halal slaughter; excessive legislation; lack of precision in terms of training requirements).

### Cost parameters

Efforts to provide **data on the cost of stunning** were made by some 34 respondents, although the data provided was not comprehensive. For example, only 25 respondents provided data on electricity consumption and 24 on water for cleaning.

Presentation of these data is complicated due to the potential for the size of the slaughterhouse and species slaughtered to have an impact on cost parameters. Whilst the sample is sufficient to allow a breakdown by throughput for waterbath systems, this is not possible for CAS systems which are presented together. In all cases, data are aggregated regardless of species.

Category (system and throughput)	Repairs (% of installation cost)	Labour DOA (hours per day)	Labour hanging (hours per day)	Labour cutting (hours per day)*	Other labour (hours per day)	Electricity (kwh per day)	Water for stunning (m <sup>3</sup> per day)	Water for cleaning (m <sup>3</sup> per day)	Gas (to. per day)
WB under 1,000	3.0%	1	6.0	6	3.5	1.24	8.1	0.8	N/A
WB 1,000-2,999	9.4%	4.8	77.5**	16.75	2.8	3.4	2.9	1.3	N/A
WB 3,000-5,999	0.1%	0	32.0	0	8.0	N/A	3.0	65**	N/A
WB 6,000-8,999	6.4%	15.4	92.8	20.4	21.9	4.3	6.8	1.8	N/A
WB 9,000-11,999	3.75%	6.75	64.6	284	4.0	6.5	3.2	0.3	N/A
WB	7.5%	13.5	128.3	13	5.0	3.5	10.5	1.5	N/A

<sup>84</sup> Some respondents expressed more than one concern.

12,000+									
<b>WB all</b>	<b>6.1%</b>	<b>10.6</b>	<b>80.1</b>	<b>60</b>	<b>10.9</b>	<b>4.0</b>	<b>6.3</b>	<b>5.0</b>	<b>N/A</b>
<b>CAS</b>	<b>11.25%</b>	<b>8.6</b>	<b>80.5</b>	<b>107</b>	<b>15.0</b>	<b>144.0</b>	<b>2.4</b>	<b>2.5</b>	<b>5.3</b>

\*It should be noted that the data presented on labour for cutting is not of practical use as this does not just depend on system and slaughterhouse size, but also whether a slaughterhouse performs its own cutting; if yes, to which degree; and the end markets it is providing for. Data in this column therefore should not be compared, and is not used in the study.

\*\* These figures are considered to be disproportionately high. Unfortunately, given the fact the survey is anonymous, it has not been possible to follow up with the respondents to clarify the figures provided.

### Quality aspects

Some data were provided by respondents on the **current and expected future reject levels of production, and the economic impacts of this**. Average figures are presented, by stunning system, in the table below. It is important to note that reject levels are a function of end market as well as quality. For example, haemorrhaging may not be apparent in a whole bird, but would be when portioned; reject level is therefore more than simply a measure of relative quality.

	<b>Waterbath</b>	<b>CAS</b>
Current reject level %	1.25% (16 respondents)	1.25% (5 respondents)
Current economic impact	€3,221 (8 respondents)	No estimate provided
Expected future reject level %	11.8% (from 15 respondents)	N/A
Expected future economic impact	€7,139 (from 4 respondents)	N/A

Note: differences between reject levels and economic impacts can be explained by the number of respondents providing estimates; these are indicated in brackets after each average figure.

### Installation costs

The **average cost of the installation of different systems** is presented in the table below. Two average figures have been calculated, one for CAS and one for waterbath systems. It should be noted that there are various factors which cause difficulties in performing a more detailed analysis of the data, *inter alia*, the small size of the data pool, the differing years of installation of the stunning system, the throughput of each slaughterhouse and the Member State in which each slaughterhouse is located which will impact on, for example, labour costs associated with installation. However, it is clear from the data that waterbath systems are cheaper to install and are less likely to require the alteration of buildings.

	<b>Waterbath</b>	<b>CAS</b>
Full cost of installation	€119,047	€1,300,000
Cost of stunner alone	€61,554	€500,000
Alterations to building required	Yes: 25%	Yes: 40%

### Comparison of old and new stunning systems

No meaningful data were provided by respondents in terms of the **differences in costs between stunning under the previously installed and presently installed systems**.

Five respondents explained their **motivations for changing their stunning system**. Four of these respondents have CAS systems installed at present, while one has both CAS and multiple-bird waterbath systems installed. The motivations provided for switching from a waterbath system were:

- Speed and degree of mechanisation (2 respondents).
- Quality / customer requirements (1 respondent).
- Animal welfare and working environment (2 respondents).

### **Future plans to invest in stunning systems**

Some 26 respondents (68%) do not intend to invest in another stunning system in the near future, while 12 respondents (32%) do. Of these 12 respondents, nine presently have a waterbath system, one has a CAS system and two have both waterbath and CAS systems.

- The slaughterhouse which already operates a CAS system intends to switch to a biphasic CO<sub>2</sub> system.
- Of the two slaughterhouses with dual systems, one intends to move to a biphasic CO<sub>2</sub> CAS system while the other intends to move to either a high frequency waterbath stunner, or to a CAS system.
- Of the nine slaughterhouses with waterbath systems, one intends to replace their existing waterbath system with another waterbath system. Four intend to install CAS systems, with one of these slaughterhouses explicitly mentioning quality concerns as the driver for this move. Two intend to either install CAS systems or head-only systems if these prove to be effective. Two did not specify the system they planned to install.

Slaughterhouses planning to invest in a new system were, with one exception in each case, larger slaughterhouses (with throughputs above 6,000 birds per hour; generally around 8,000 birds per hour) and based in north west Europe. The exceptions were a 1,000 bird per hour slaughterhouse in north west Europe, and one large (over 9,000 bird per hour) slaughterhouse in eastern Europe.

### **Other comments**

Other comments included:

- Concerns about the impact of the parameters specified under Regulation (EC) No 1099/09 on quality.
- Concerns that halal slaughter has not been fully taken into account under the new legislation.
- Doubts about the animal welfare benefits of CAS vis-à-vis multiple-bird waterbath stunning systems.

## **Appendix 4: Methodological considerations**

### **Data collection**

Data collection was completed using the following methods:

- **Literature review.** During the course of the study, approximately 100 pieces of literature were examined. Some of this was identified through specific searches for relevant literature, while some was provided by interviews during the course of the study. Not all literature which was identified was used for the study; a list of literature which was considered relevant and was used can be found in the reference list (section 5).
- **Databases.** In some cases, databases were used in order to collect relevant data. The main database used was Eurostat (both the agricultural statistics and Comext).



- **EU level interviews.** Two phases of EU level interviews were completed; an exploratory phase and a main phase. A full list of the organisations contacted and/or interviewed can be found in section 6. Interview guides were presented in the inception report, which in turn was approved by the steering group.
- **Case studies.** Case studies were completed in nine Member States: France, Germany, Italy, Netherlands, Poland, Romania, Spain, Sweden and the UK. The case studies can be found in the case study annex. Interview guides for case studies were presented in the inception report, which in turn was approved by the steering group.
- **Survey of AVEC Members.** During the exploratory phase, a survey of AVEC Members was completed. The findings of this survey were built on during the main phase of the study through the case studies and EU level interviews. The survey was presented in the inception report following its launch.
- **Survey of Competent Authorities.** During the main phase of the project, a survey of Competent Authorities was completed. The results of this survey are presented in Annex 2. The survey was presented in the inception report, which in turn was approved by the steering group.
- **Survey of Slaughterhouses.** During the main phase of the project, a survey of slaughterhouses Authorities was completed. The results of this survey are presented in Annex 3. The survey was presented in the inception report, which in turn was approved by the steering group.

## Synthesis

Data which was collected during the data collection phase was validated and cross checked prior to use. Data presented in the report, including most notably the data presented in tables, has passed through the validation and cross checking phases.

The source of data is indicated in the footnotes of the corresponding table. Any methodological considerations are either explained in the footnotes of the table, or in the main text accompanying the table.

## Cost model

The methodological considerations for the cost model are examined in section 2.6.2. Data used for the cost factors for the cost model is taken from the manufacturer estimates (45% weighting), slaughterhouse survey (45% weighting) and literature (10% weighting).

Input factors are multiplied by the following unit costs in order to arrive at the total cost for stunning:

Factor	EU average	High cost case	Low cost case	Source
Labour (per hour)	€23.10	€39.30	€3.50	Eurostat (2010)
Electricity (per kwh)	€0.0935	€0.2041	€0.0649	Eurostat (2012)
Water (per m3)	€1.05	€2.1	€0	EU legislation, 2010 <sup>85</sup>

<sup>85</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010SA0009:EN:HTML>



Gas (per tonne)	€300	€300	€300	Manufacturer
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