Energy efficient and renewable technologies in decarbonising pig & poultry farming

Barry Caslin – Teagasc
barry.caslin@teagasc.ie

Teagasc
Agriculture and Food Development Authority

Reminder Key Agricultural Emissions

Greenhouse Gas (GHG)	Where from on the farm?		Total: 20.1 Mt of CO2 eq in agriculture of which
Carbon Dioxide CO_2	Burning of fossil fuels		0.94 Mt of CO_2 eq **5%**
Methane CH_4	Natural bi-product of enteric fermentation		12.97 Mt of CO_2 eq **64%**
Nitrous Oxide N_20	Naturally produced; emissions can be increased by cultivation & N fertiliser		6.3 Mt of CO_2 eq **31%**

CO_2 Emission Factor 2018

Energy Source	CO_2 emission kg/kWh
Grid electricity	0.296
Natural Gas combustion - Heating	0.205
Coal - combustion	0.340
Kerosene	0.257

If I use 4,500 kWh of electricity in the year I'm producing 4,000 x 0.375kg = 1,332kg or **1.3tonnes** of CO_2

Kerosene Oil has 10.5 kWh per litre. 1,000 litres = 10,500 kWh
10,500 x 0.257 = 2,698 kg or **2.7 tonnes** of CO_2

Why invest in renewable energy

- An opportunity to generate an income through Government incentives
- Makes use of on farm resources from slurry to forestry, straw, wind and rivers.
- Energy generated can be used to generate additional income
- Reduction in GHG emissions

Energy Awareness

- Develop tools to create awareness among staff
- SEAI offer a range of training and supports around energy management and standards.
- Classroom based energy management training for companies
- More effective use of thermostats, time clocks, motion sensors and insulation
- Vehicle checks and maintenance
- Assess on-farm storage facilities, for example, potato stores, to ensure that insulation and natural ventilation is utilised and energy is used efficiently

Energy Use in Pig Units – 36 – 16 kWh per pig produced.

- Heating, lighting & Ventilation
  - Farrowing (8 – 4 kWh)
  - Weaning (9 – 3 kWh per pig produced)
  - Finishing (10 – 6 kWh)
- Motive power – Pumping & Conveying (3-1 kWh per pig produced)
- Manure handling – Pumping / Scraping
  - 6 – 2 kWh per pig produced.

Energy Efficient Pig Units

- Large power demand from heating, ventilation and lighting.
- Systems are very intensive with power costs overlooked with a drive for greater productivity.
- Greater emphasis needs to be put on energy efficiency
- Improving the performance of buildings and systems are the first steps

Lighting – Pig Units

- Lighting accounts for one of the greatest inefficiencies
- Fluorescent lighting and lower energy can reduce costs by up to 80%
- LED allows to match lighting levels and colour to animals needs
- Many units still use tungsten bulbs which are cheap but inefficient at 2 – 4 kWh ppp
- Fluorescent strip lighting can reduce this to 0.8 kWh ppp

3.2 kWh x 0.296 kg of CO_2 = 0.95 kg of CO_2 ppp

Selecting high efficient pumps aerators and separators

- Should be considered when specifying or upgrading motors for feed or manure handling
- Fitting a Variable Speed Pump can reduce costs by 30%
- Inefficient motors typically require 6kWh ppp
- Efficient motors 2 kWh ppp
- Saving 4 kWh ppp

4kWh x 0.296 kg of CO_2 = 1.2kg of CO_2 per pig produced

Insulation of pig units

- Good insulation reduces amount of heat lost and heat coming in.
- Heat lost through the walls of the building requires supplementary heat increasing costs.
- Fitting composite panels containing solid polyurethane insulation, protected from moisture ingress, is recommended.

  - Typical insulation 9kWh per pig produced
  - Best Practice = 3 kWh
  - Saving 6kWh per pig produced

6kWh x 0.296 kg of CO_2 = 1.77kg of CO_2 per pig produced

teagasc
Agriculture and Food Development Authority

Ventilation

- Ventilation is designed to optimise the living conditions of pigs
- Typical finishing building ventilation fans using 7.2 kWh per pig produced (ppp)
- Best practice could achieve 4 kWh ppp
- Saving – 3.2 kWh ppp

3.2 x 0.296 kg of CO_2 = 0.95kg of CO_2 per pig produced

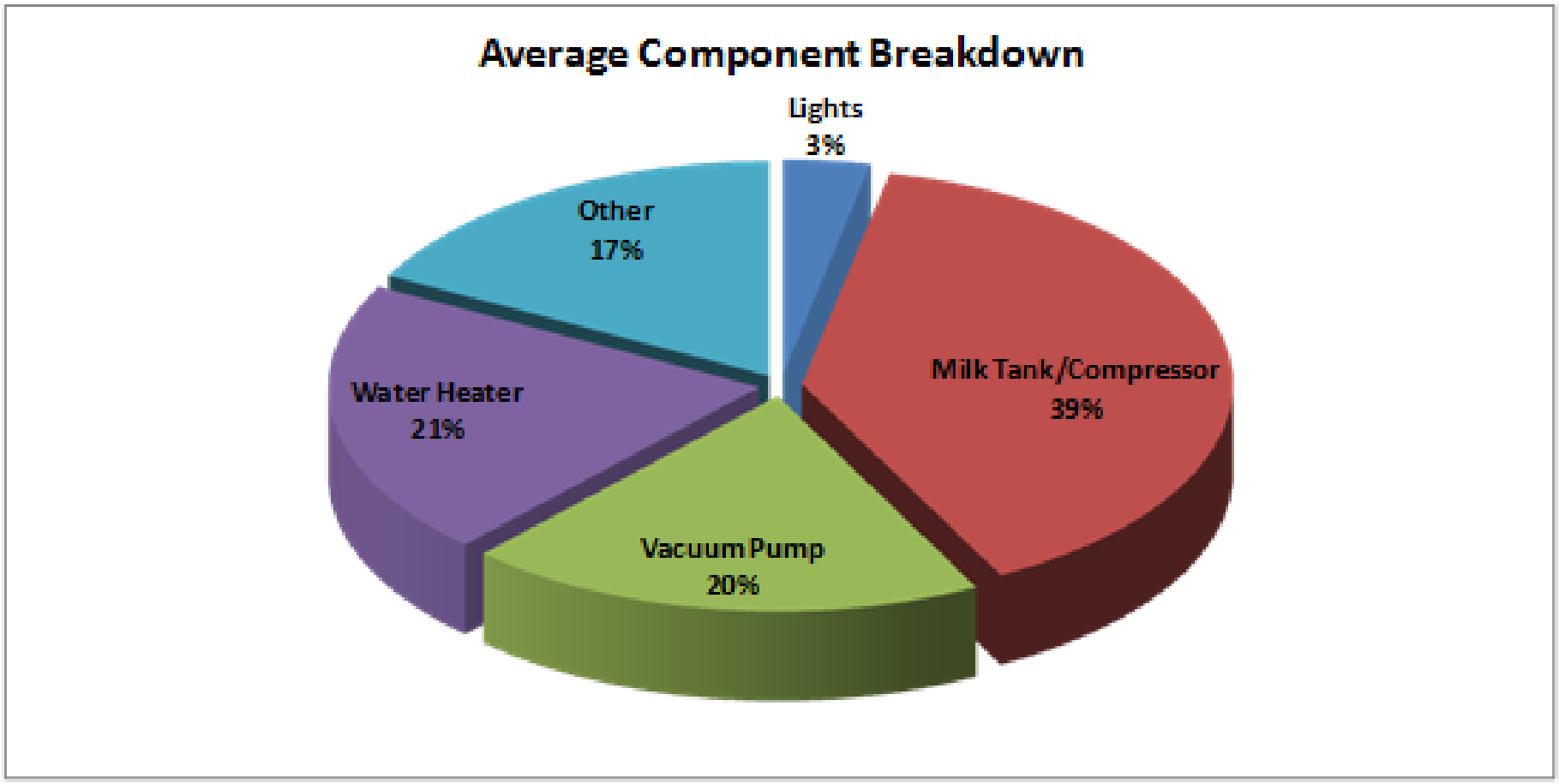
Fit efficient fans

- A single fan in a finishing building will consume its own value in 12 months
- Paying 10% more on a more energy efficient fan will pay for itself in the same time
- Clean dust & debris from fan blades
- Typical finishing building 10 kWh ppp
- Best practice efficient fans 6 kWh ppp
- Saving 4 kWh ppp

4 x 0.296 kg of CO_2 = 1.2kg of CO_2 per pig produced

teagasc
Agriculture and Food Development Authority

Energy Use in Dairying



Energy Use in Dairying

- Energy monitoring, management & benchmarking
- Field operations savings
- Optimise milk cooling systems
- Basic improvements in water heating
- Lighting systems improvements
- High efficiency motors and VSD's

Variable Speed Drives

- SEAI grant aid 40% for VSD – 2017, 2018, 2019 (€1m)
- VSD reduces electricity consumption by 56 – 65%
- Vaccum pumps account for 7.12 Wh per litre of milk produced

Year	No of grants paid	CO2 Emissions without VSD	CO2 Emissions with VSD	Annual Co2 Savings
2017	48	142	71	71
2018	69	184	92	92
2019	111	251	125	125
overall	228	577	288	288

Energy Efficiency on Poultry Units

- The first step is know how much is used where and when.
- Regular recording of utility meter readings or fitting advanced data logging equipment.

Control Airflow

- Insulating buildings and reducing air leakage by sealing gaps in walls, around doors, windows, louvres or fans are priorities
- Improving insulation keeps heat in and reduces “solar gain” in the summer, helping to keep the inside cool, reducing energy requirements for heating and ventilation
- About 400mm of insulation is recommended,

Ventilation - poultry

- Match duct and fan sizes to the ventilation system
- Regularly clean and maintain fans, ducts and louvres to improve airflow
- Replace old fans with energy-efficient models
- Use recirculation fans (cost about €300) to improve heat distribution (especially for direct acting heating systems) – heating fuel saving likely. Link to first-stage fans to maintain normal airflow
- Seal gaps around doors, walls, windows and ventilation louvres to reduce air leakage – increases static pressure and improves ventilation efficiency and natural air mixing
- Fit proprietary “bell-mouths” to fans or “cones” to outlet fans to increase aerodynamic efficiency by typically 10%

Teagasc
Agriculture and Food Development Authority

Heating on poultry units

- Position thermostats carefully to avoid overheating buildings (avoid draughts/doors)
- Insulate roof, floor and walls (insulate concrete mass walls to the ground)
- Link heating and ventilation systems
- Use heat recovery to pre-heat incoming air with warm extract air – heat energy savings of 10-25% are achievable
- Service boilers regularly – clean heat transfer surfaces
- Replace ageing boilers with energy-efficient models or renewable energy systems (or example biomass boiler, ground/air-source heat pump, solar thermal)
- Consider radiant heaters to directly heat floor area and minimise general air temperature rise
- Restrict chicks to smaller areas with zonal control/brooding curtains –ensure a tight seal

teagasc
Agriculture and Food Development Authority

Lighting poultry

- Reduce lighting (within regulations) – current minimum is 20 lux over at least 75% of floor
- Replace old incandescent and tungsten halogen lights with energy-efficient fluorescent systems inside and high pressure sodium or metal halide lamps outside
- Consider LEDs – modern LEDs are dimmable and fit existing sockets. Cost is higher than standard bulbs (€9/bulb versus €0.40-0.60), but lifespan is longer (50,000hrs v 1,000hrs) and use less energy (8W) to produce twice as much light
- Use photoelectric sensors to control lighting in buildings with windows.

Other energy saving - poultry

- Use multiple electronic sensors at bird height to improve ventilation and heating accuracy – consider systems that record temperature/ventilation data to aid management
- Inverters (variable speed drive) to speed up or slow down fans as required (rather than just on or off)
- Commission an energy audit

Energy Use in Horticulture

- Monitor your energy use and track consumption.
- Implement a turn it off/ Close it/ turn it down campaign with staff.
- Check insulation and sealing of cold stores
- Clean & maintain all fans
- Calibrate control sensors
- Maintain refrigeration equipment regularly
- Clean lights regularly (bulb + fitting)

Energy Use in Horticulture

- Match tractor and implement combinations for optimum output
- Repair water leaks in irrigation pipes
- Consider VSD on pump sets
- Use simple automatic controls such as time switchers, occupancy sensors and thermostats on energy consuming equipment.

- Thank You
- Any Questions?

- Barry Caslin
- Teagasc – Energy and Rural Development Specialist
- barry.caslin@teagasc.ie

Teagasc
Agriculture and Food Development Authority