5.2.	Appropriate slurry processing and storage systems
NPA Location	**Description and Purpose:** Before the use of the slurry e.g. in the field, proper process techniques must be applied.
Finland, Iceland, Northern Ireland, Republic of Ireland, Scotland	For farmers, the loss of NH_4^+ via the NH_3 emissions will reduce the fertiliser value and amount of the animal manure. Therefore the implementation of measures to reduce NH_3 emissions may contribute to reduce the oversupply of N to crops. One of these measures is the 1) acidification of slurry which can decrease the amount of NH_3 emissions from the animal house, the store and after having applied the slurry to the land. Others include 2) solidification/stabilisation techniques which can be implemented but properly modified and adapted on site-specific applications (taking always into consideration the end-use of the treated material and the chemical characteristics of the slurry); 3) slurry cooling – a process which has similar characteristics with the geothermal heat generation. It also lowers ammonia levels in the stable thus contributing to creating better environmental and health conditions (Joergensen, 2009; European Commission, 2018). The Best Available Techniques (BAT) Reference Document for the Intensive Rearing of Poultry and Pigs (EC, 2017) provides the comprehensive list of all best available techniques for the slurries processing. Slurry Storage Systems Storage systems have an important influence on three key environmental burdens arising from farm operations: global warming potential via CH_4 and N_2O emissions, and eutrophication and acidification via NH_3 emissions. According to the EC (2018), the best practice is to install tall (> 3 m) slurry tanks with a comparatively small exposed slurry surface area (new stores), and to cover slurry with some form of fixed or temporary cover (retro-fit existing stores). The maximum duration of slurry storage depends on the capacity of slurry stores in relation to slurry generation (animal numbers). It can have a significant influence on the efficiency and environmental impact of slurry application. According to the EC (2018), insufficient slurry storage capacity leads to winter application of slurry onto wet soils, when a high proportion of N may be lost via runoff and leaching, and when plant uptake is low. Thus, adequate storage capacity is a second key component of best practice. The Ontario Ministry of Agriculture, Food and Rural Affairs provides excellent Fact sheets and design guide for different types of of Slurry Storage Systems used in Canada (Hilborn, 2010).
	Nutrients Reduction (Effectiveness): EC (2018) cited research by Cuttle et al. (2007) who stated that increase in a slurry storage capacity from an average of three to 6 months, under a cool, temperate, wet climate (UK) resulted in: • 25% reduction in slurry P losses to water • For arable land, a 10-20 kg N/ha (20-40%) reduction in annual N leaching via optimised application timing, or a 15-30 kg N/ha (30-60%) reduction if fertiliser application rates are reduced accordingly; • For grassland, a 2-5 kg N/ha reduction in n leaching for dairy farms, and 1 kg N/ha reduction for beef farms.
	Recycling/Recovery: The number of technologies/products applied on farms at the full scale are limited. More research is needed.
	Climate Change Mitigation: According to the EC (2018), under worst case open lagoon systems, slurry storage can contribute up to 38% of farm system GHG emissions, 30% of farm system eutrophying emissions, and 52% of farm system acidifying gas emissions for a large dairy farm. The type of slurry storage system, in particular the surface area exposed to the atmosphere in relation to the slurry volume, strongly influence CH_4 and NH_3 emissions to the atmosphere. Life cycle assessment of a large dairy farm system where animals are indoors for 10 months of the year showed that shifting from lagoon storage to tank storage with a crust cover can reduce farm-level GHG emissions by 29%, eutrophying emissions by 25% and acidifying gas emissions by 42%.
	Operation and Maintenance (O & M): EC (2018) summarized best measures for slurry management and storage identified by Newell-Price et al. (2011). These include: 1) Increase the capacity of farm slurry (manure) stores to improve timing of slurry applications; 2) Adopt batch storage of slurry (slurry should be stored in batches for at least 90 days before land spreading; fresh slurry should not be added to the existing storage during this storage period); 3) Install covers on slurry stores; 4) Allow cattle slurry stores to develop a natural crust (e.g. retain a surface crust on stores, composed of fibre and bedding material present in cattle slurry, for as long as possible).
	Cost: EC (2018) summarized data reported in EC (2013) showing necessary investments and annual costs for four different usable storage capacities (e.g. 500, 1000, 3000 and 5000 m^3). For example, the investments for a 500 m^3 storage unit were 100 €/m^2 for a tent roof, 39.5 €/m^2 for floating bricks and 10.2 €/m^2 for light bulk materials, while for a 5000 m^3 storage unit they were 46, 39.5 and 7.6 €/m^2, respectively. Klimont and Winiwarter (2011) calculated storage investment costs for different storage scales (Figure 1).