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## From chemical fingerprints to environmental footprints: advancing feed production through near-infrared spectroscopy, Life Cycle Assessment and novel Artificial Intelligence

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Process Analytical Technologies have been the key technology of quality maintenance and improvement in process industry. Quality is however only one indicator of process excellence: Safety, Cost, Delivery, Maintenance and specifically Environment are strongly complementary determinants of process value. The rising societal demands on sustainability of contemporary process industry has made specifically Environmental impact increasingly relevant, demonstrable by the implementation of CSRD into national legislation in the coming years. This however creates an interesting “collision of timelines” as the future predictions from large volumes of PAT data collide with the retrospective quantification of environmental with Life Cycle Assessment (LCA), of data that is available at time of production.

Aside from quality information, PAT data (e.g. NIR spectra) contain a wealth of information on aspects like provenance, which are the key inputs for LCA. The available sustainability data on ingredients may therefore also be used to predict the footprint of the end-product. In this way, both quality and environmental impact (and production cost) may be simultaneously predicted. This allows the producer to take control of the product footprint, like they already are used to take control of quality through PAT. We show on a case study of animal feeds, how NIR spectroscopy (1) adequately predicts all product outcomes, (2) likewise predicts ingredient provenance, thereby providing a paperless evidence basis for their origin and (3) makes transparent the economic balance underlying sustainable production.

### Type of presentation

Talk

### Classification

Both methodology and application

### Keywords

Process Analytical Technologies; Sustainability; Lifecycle Assessment

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