Assessment of the relation between methane concentrations and the methane flux of an artificial reference cow

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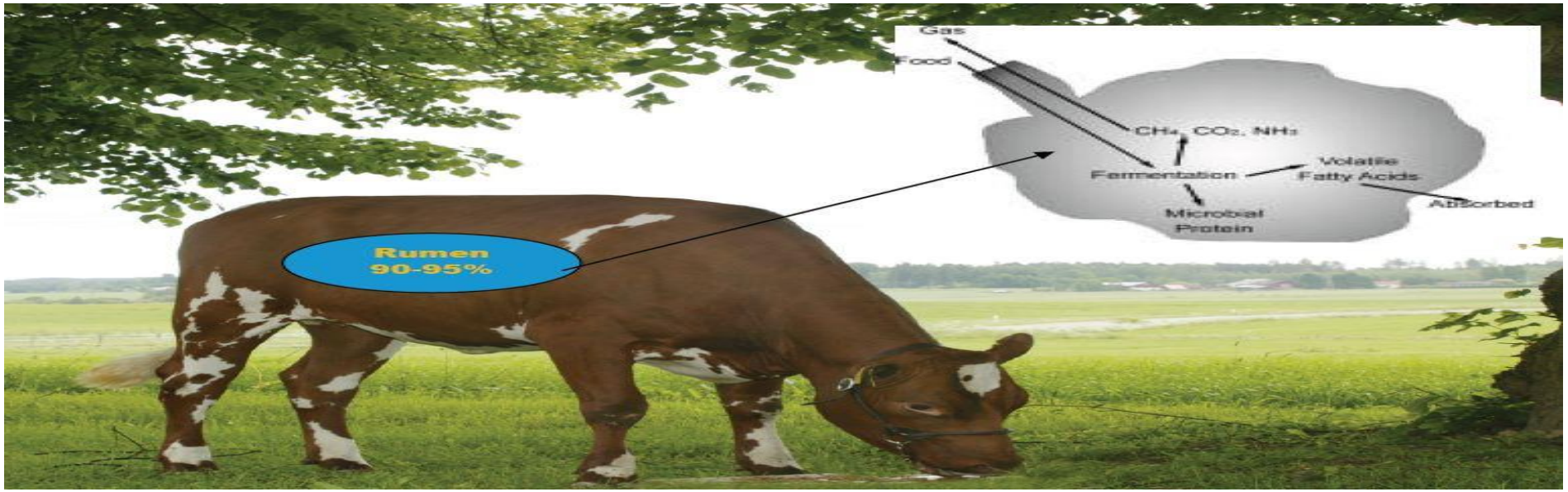
Introduction

- Methane emission from dairy cows:
  - 300 g/day
  - 15% global methane budget
  - 90~95% through nose and mouth
  - 6~10% loss of gross energy intake (Blaxter and Clappterton, 1965; Yan et al., 2010)



Introduction

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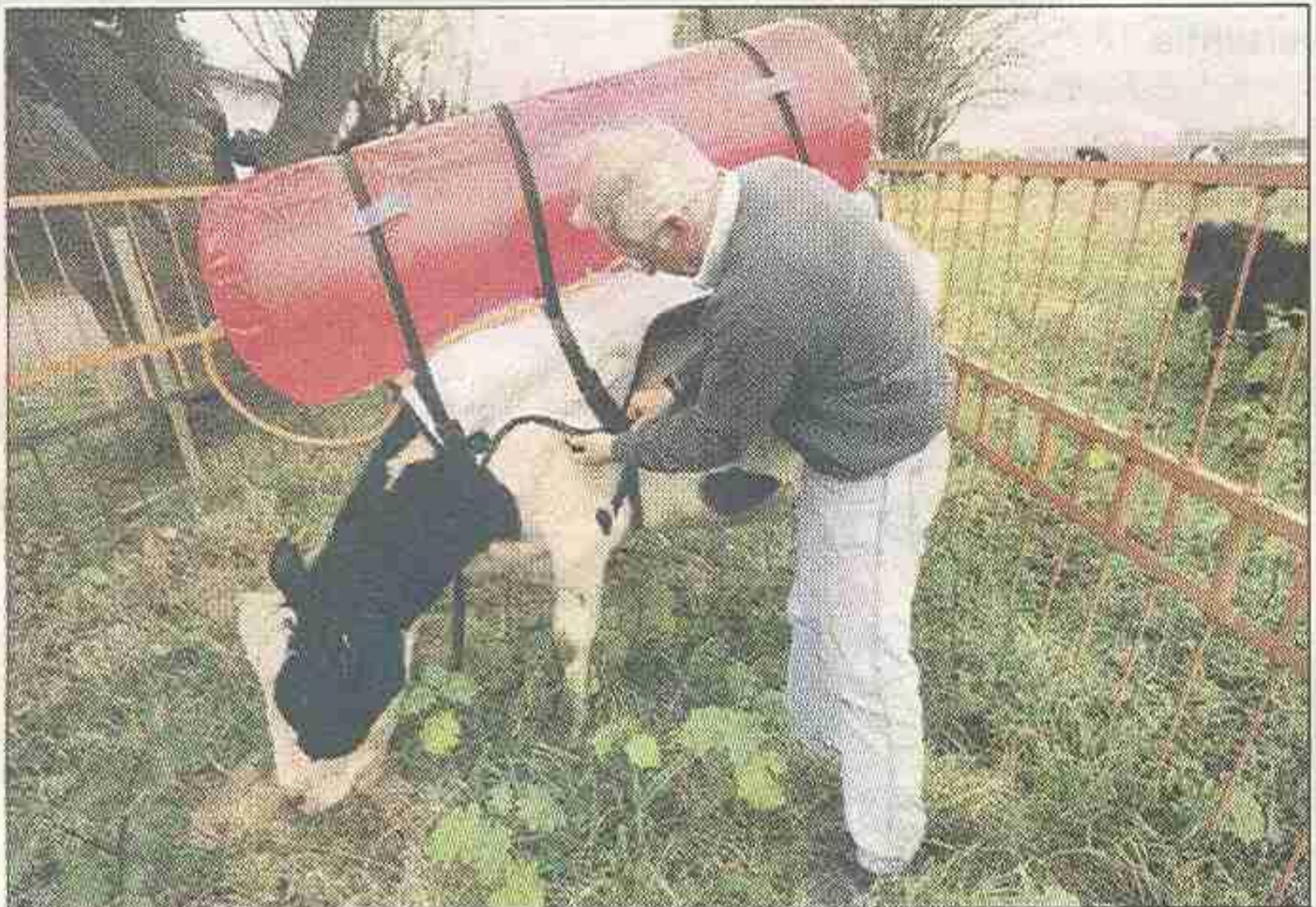
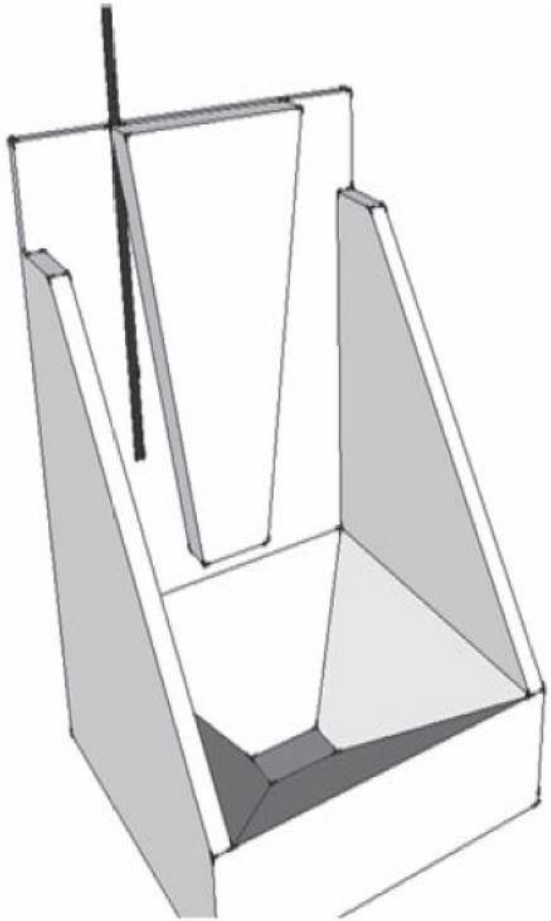


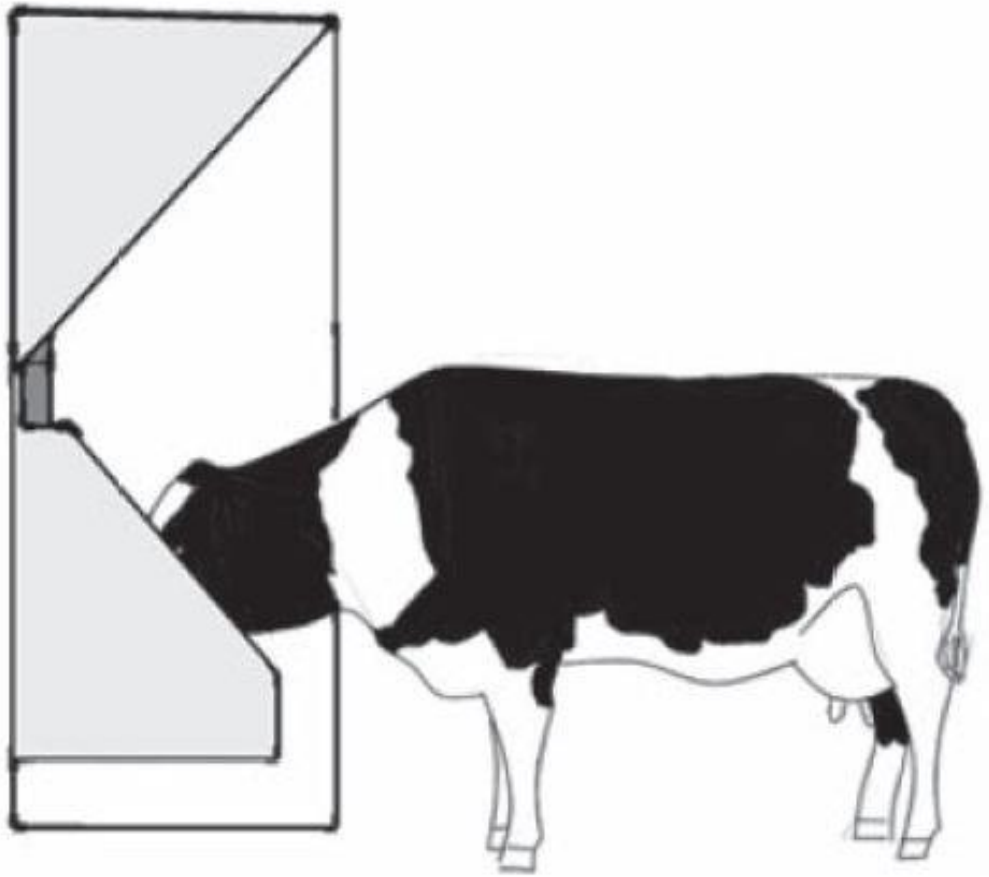
Introduction

- Methane flux methods - e.g. g/day;
  - Direct: respiration chamber (Blaxter et al., 1972)
  - Indirect: tracer gas technique (SF_6) (Grainger et al., 2007)

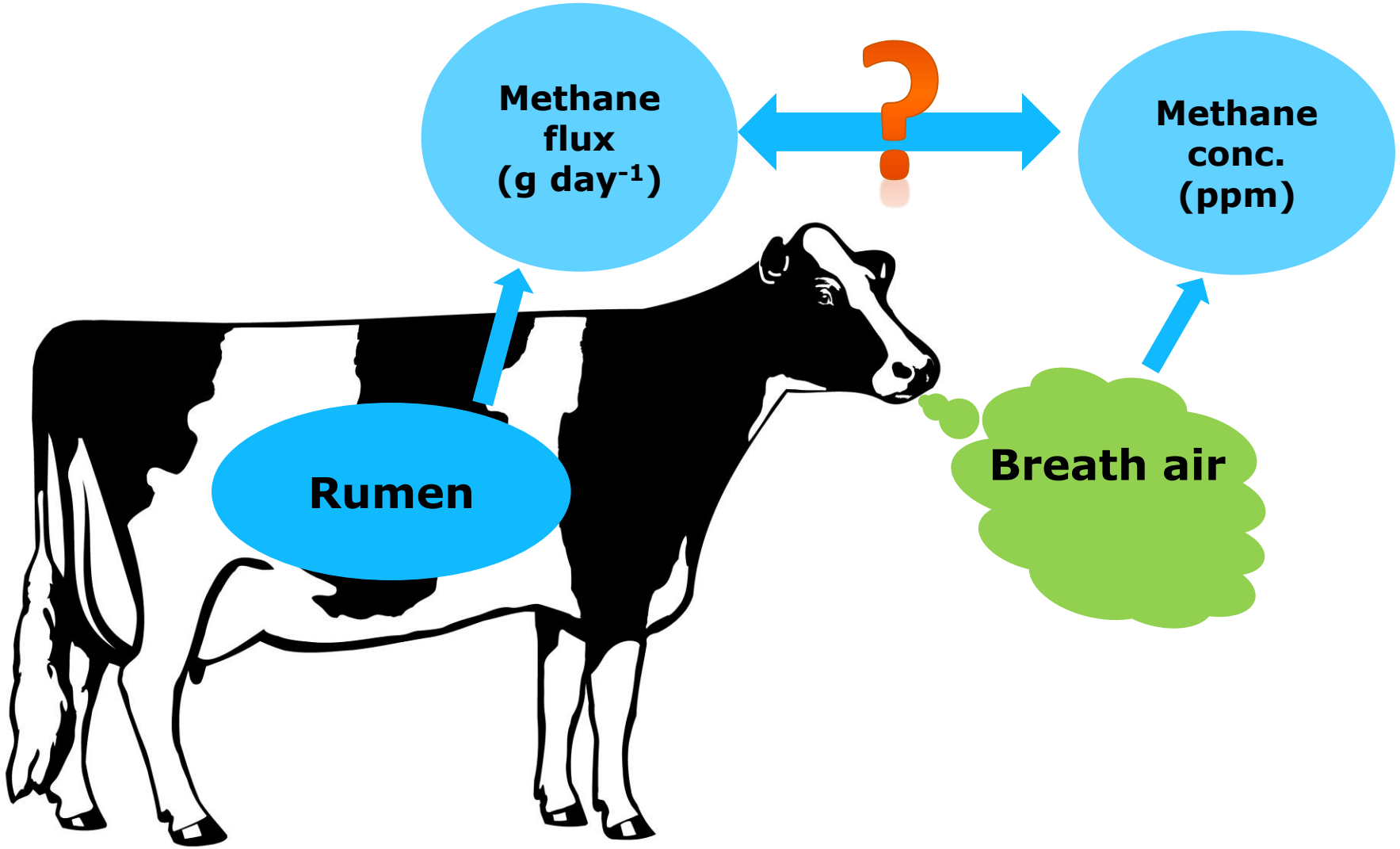
- Methane concentration method - e.g. ppm:
  - Breath methane measurement method (Garnsworthy et al., 2012; Lassen et al., 2012)

Introduction



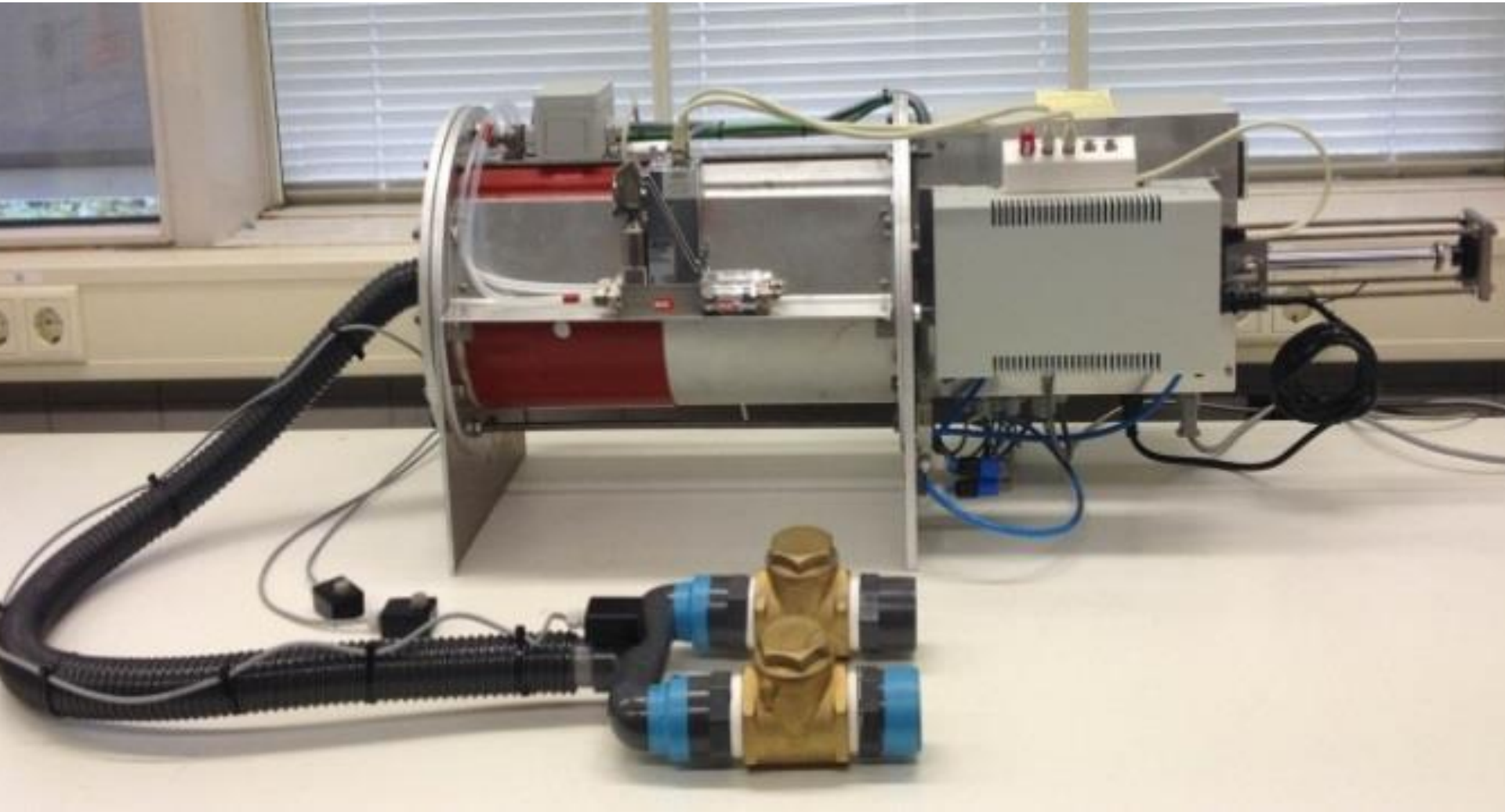


Objective



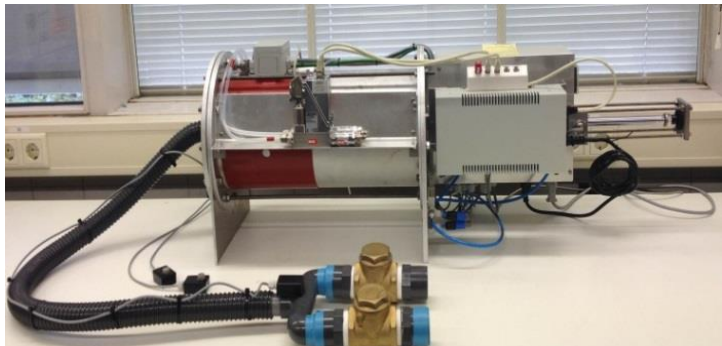
Material and methods (1)

- The artificial reference cow (Wu et al., 2014)



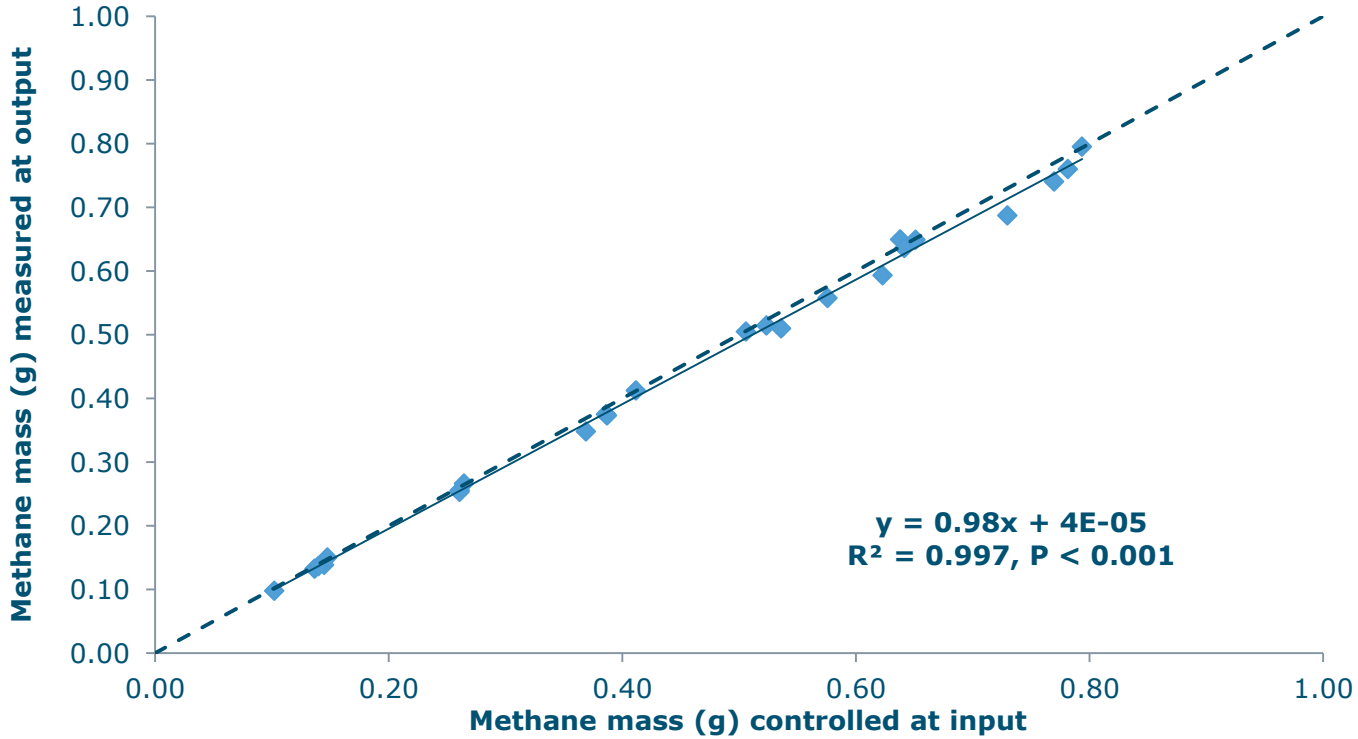
Material and methods (1)

- The artificial reference cow (Wu et al., 2014)
  - Simulate breathing of cows: lungs, resp. track, nose
  - Simulate CH_4 eructation from rumen
- Gives:
  - Controlled methane flux
  - Known methane concentration pattern
  - Concentration pattern evaluation model
- Validation of:
  - CH_4 flux rates
  - CH_4 concentrations patterns



Results and discussion (1)

- Mass balance experiment of the ARC (tidal volume of 4.4 & breath frequency 30 min-1)



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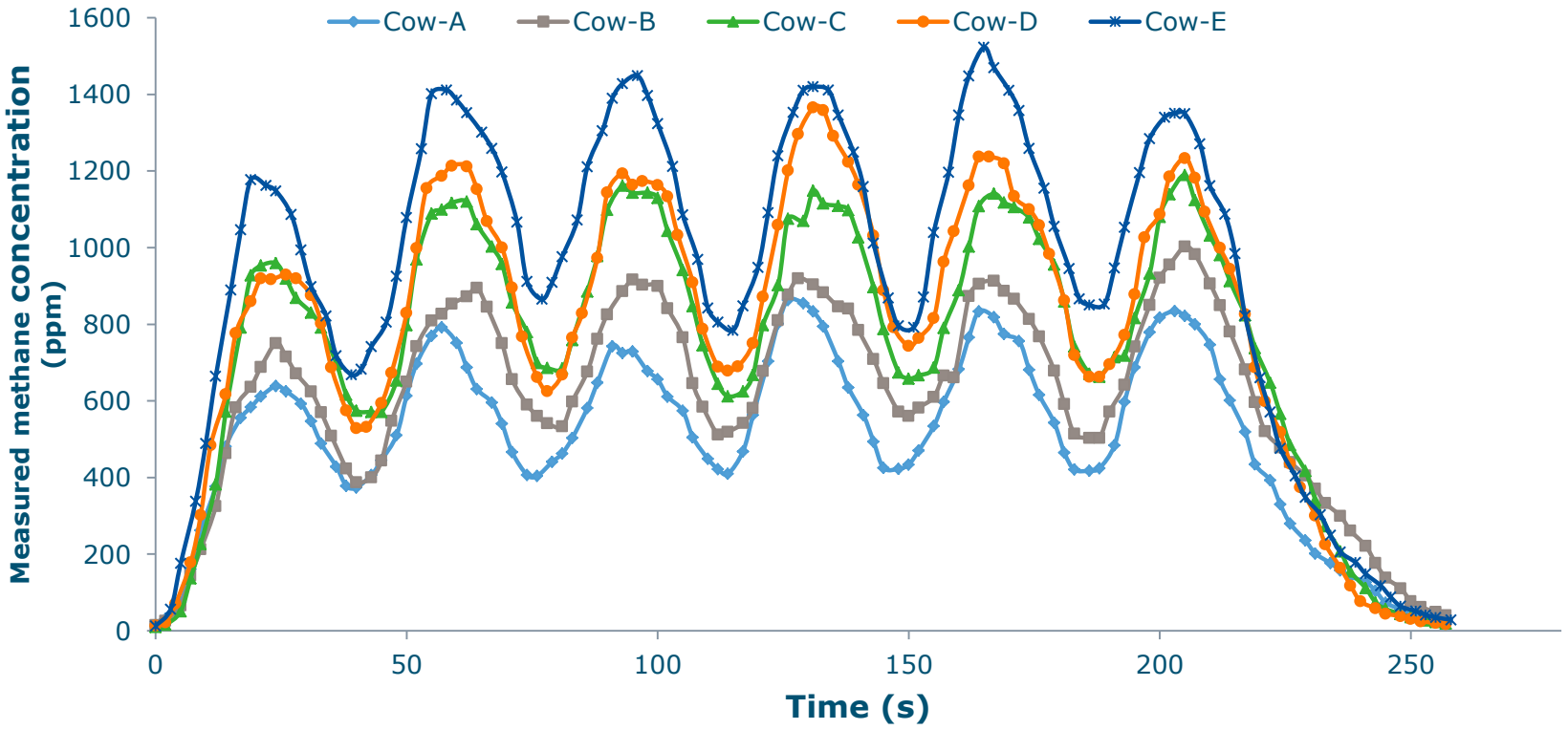
Results and discussion (1)

- Measured methane concentration pattern



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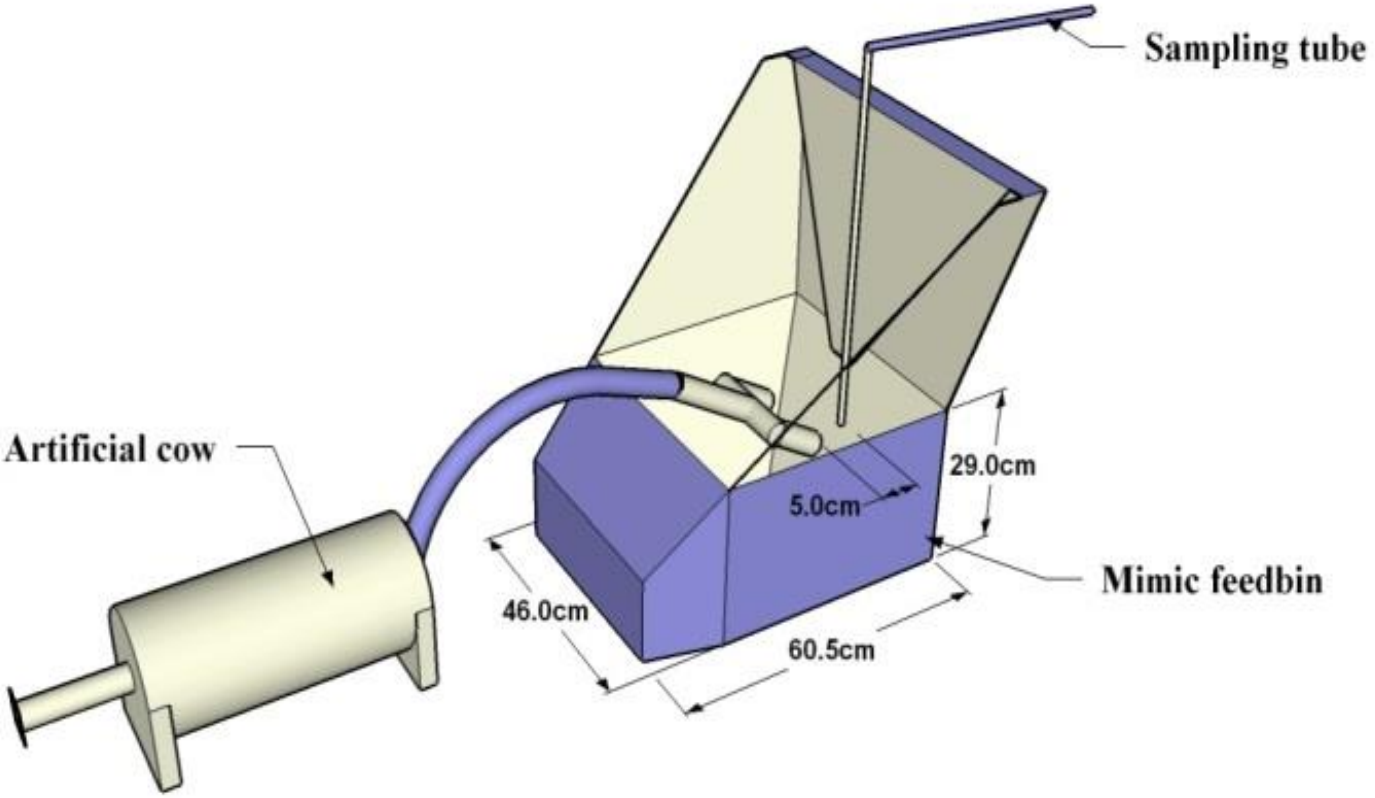
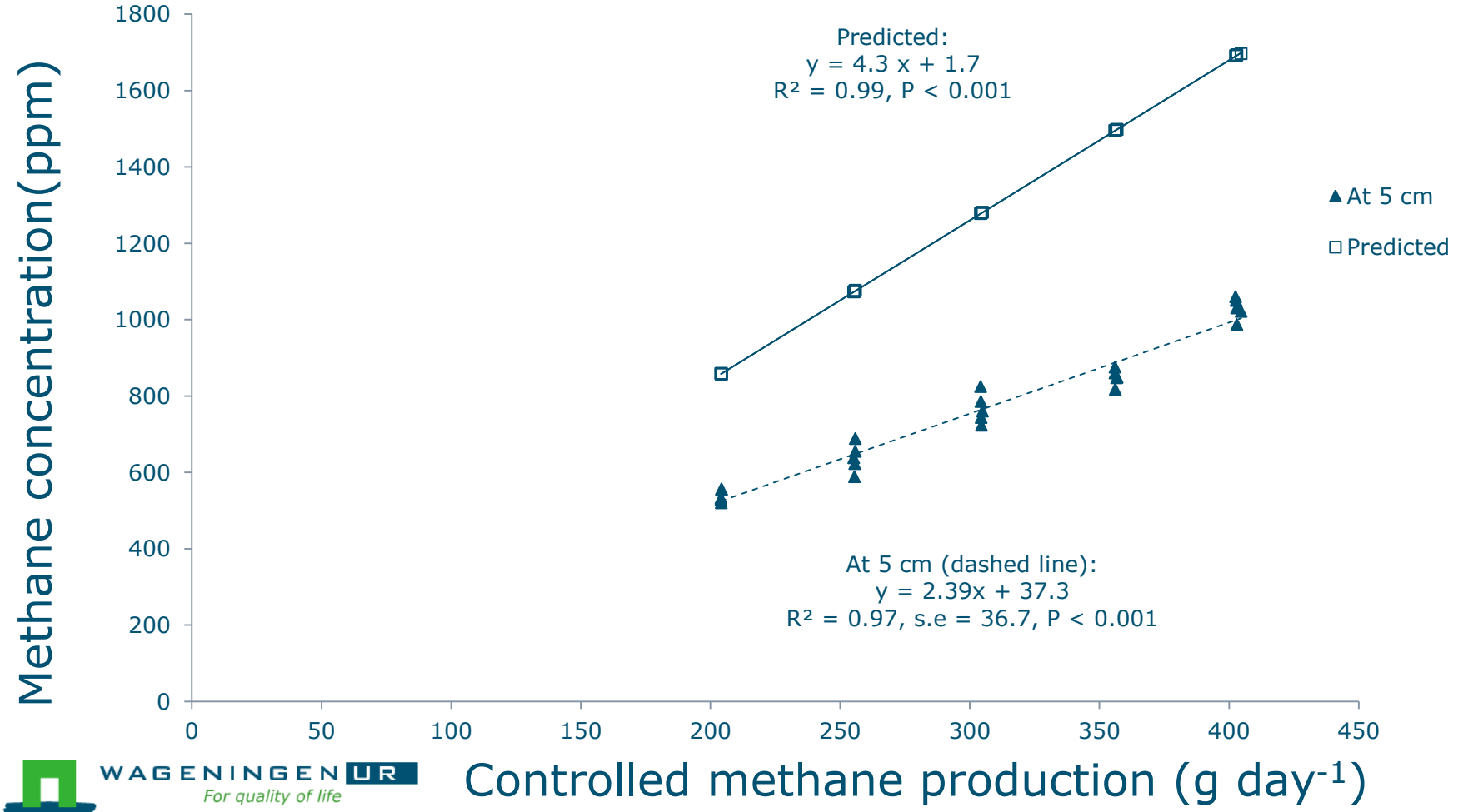
Material and methods (2)



Results and discussion (2)

Measured and predicted methane concentrations versus methane production rates; lab conditions



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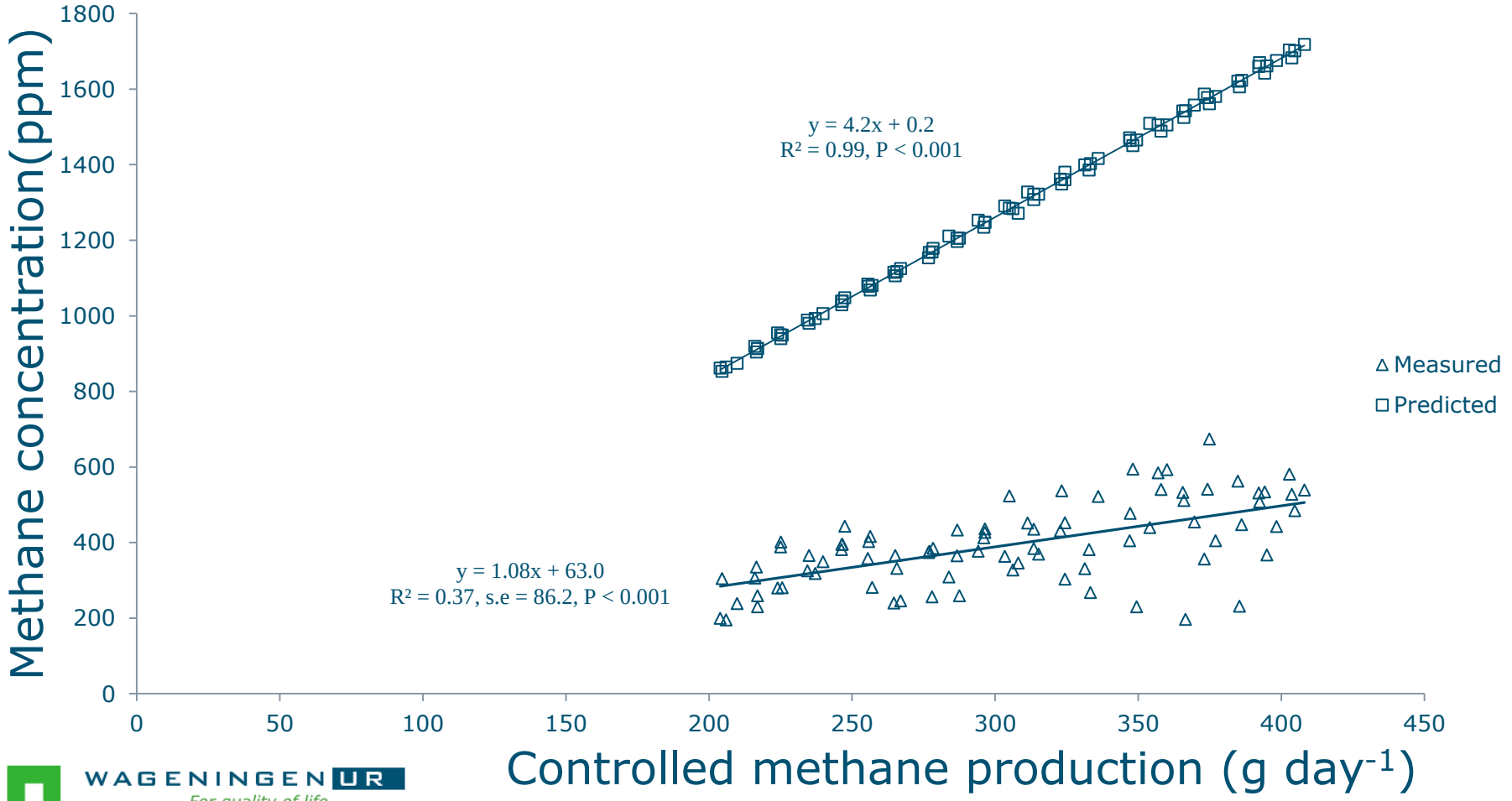
Results and discussion (2)

Measured and predicted methane concentrations versus methane production rates: barn conditions



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Conclusions

- The artificial reference cow properly represented the methane production release, and the system precisely controlled methane concentration and production.

- Breath methane concentration measurements can predict methane production rates of cows under steady laboratory conditions.

- This relation is weaker and shows more variation under disturbed / barn conditions: more research needed

Thanks!

Now
I know
how much
methane
I produce!

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