Algae 2015 event

Algae and Biogas:

Establishment of Large Scale Demonstration Centre for Algal-Bacterial Digetate Treatment and Algae Biomass Production for Further Use

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AlgaeBioGas Project

- An Eco-Innovation project (CIP-EIP-Eco-Innovation-2012)
- Duration: 2012 - 2016
- Partners:

Co-funded by the Eco-innovation Initiative of the European Union

AlgEn, algal technology center, d.o.o.

KOTO d.o.o. biogas operator, animal waste treatment facility, Ljubljana, Slovenia

Biogas Plants

- Several thousands biogas plants in EU
- Common challenges:
  - Optimisation of biogas and power production
  - Demand for affordable highly energetic substrates
  - Side products: biogas digestate, heat, flue gases (CO_2)

Biogas Digestate

- Large quantity daily
- Composition and quality is specific for each biogas plant (substrate, fermentation mode, retention time…)
- Use as fertilizer
- Separation on solid and liquid phase

Digestate as Fertilizer

Warning: This topic may be politically controversial

- By spreading the digestate we return exactly the same minerals that we removed by harvesting the energy feedstock
- Assumption: SAME area
- YES, but in liquid form:
  - highly diluted
  - high logistic cost (storage, transportation)
  - flushing the CEC of the soil
- Separation into solid and liquid phase
  - solid phase is useful as fertilizer
  - better logistics
  - same machinery
  - no liquid flush

Digestate Centrate

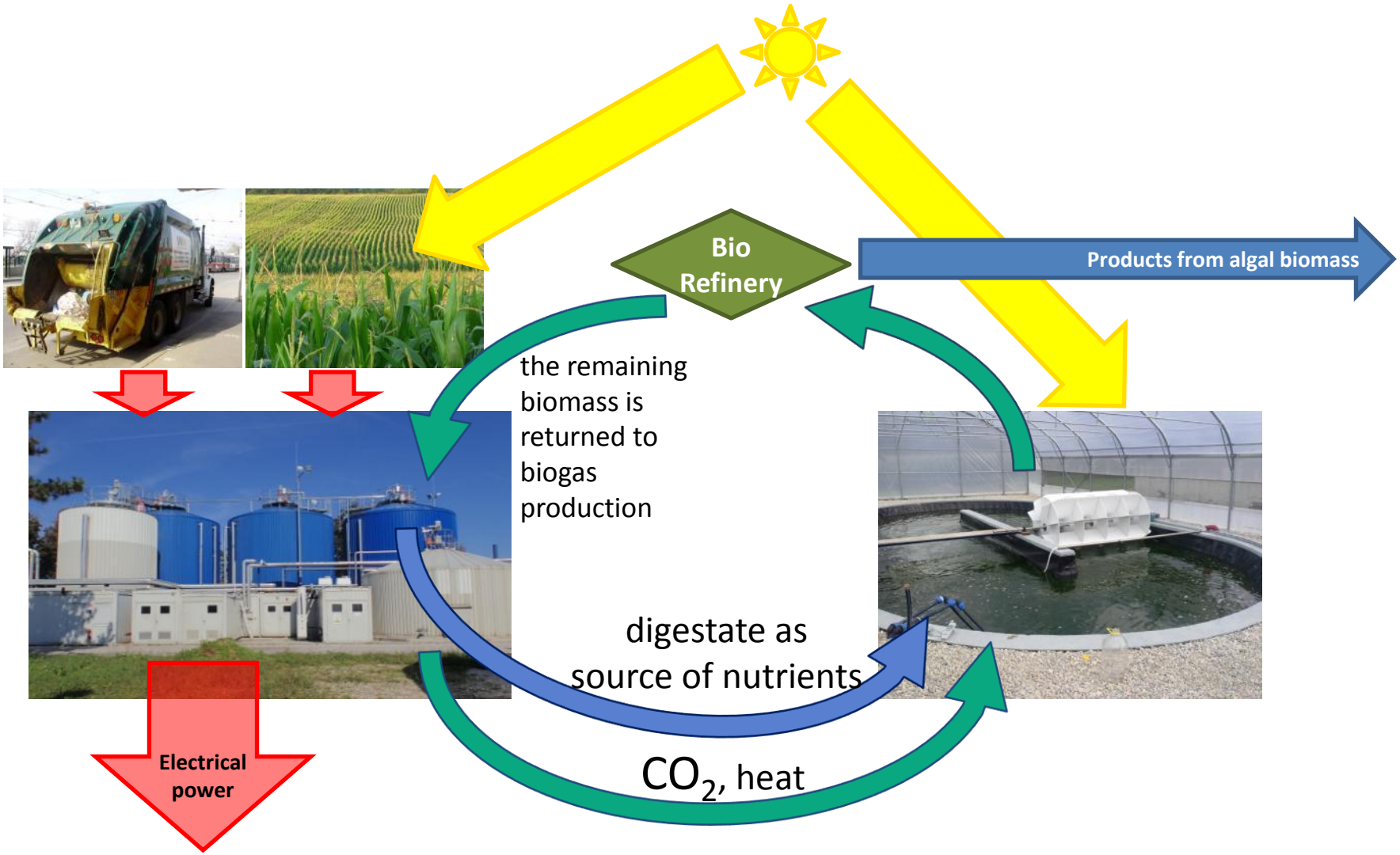
- What do we do with the liquid phase?
  - classical biological WWT is the most frequent answer
  - high cost:
    - investment
    - aeration power
    - bacterial sludge disposal
  - Nutrients are lost
    - C, N-loss = energy
    - P-loss = substance, eutrophication
  - GHG emissions
    - Aerobic treatment mostly converts biomass to CO_2

Algae and Biogas Digestate

- Many researches on lab scale:
  - Biogas digestate as a nutrient source for microalgae cultivation
  - Microalgal treatment of biogas digestate and nutrient removal from biogas digestate using microalgae
  - No pilot and no real scale instalation

- Aim of the ABG project:
  - Demonstration centre for microalgal-bacterial biogas digestate treatment and biomass production
  - Prepare technology for replication
  - Market development activities

AlgaeBioGas Basic Cycle



Possible optimizations

1. Feedstock production for biogas
2. Microalgae biomass production
   - Makes sense if we have substantial non agricultural area available
   - if we leverage on energy crop subsidies
   - if we are co-producing high value products
3. Biogas digestate treatment + biomass production
   - Makes sense always when the required area is available

Demonstration Center - Location

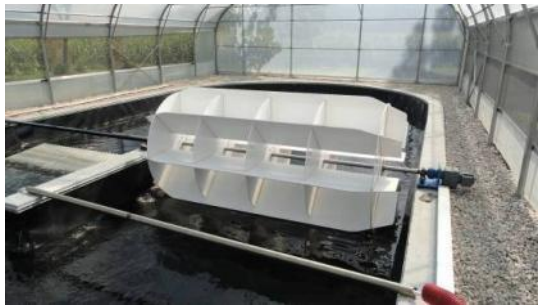
Demonstration Center – Biogas Plant

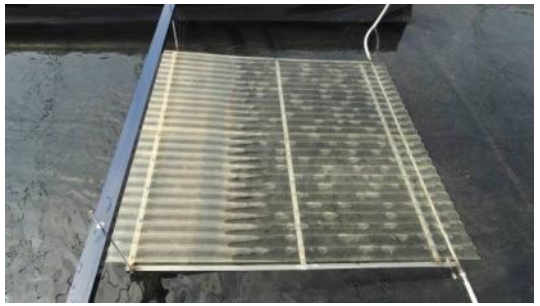
Capacity - substrat	13.000 t/ year
Electric power	526 kWe
Produced biogas:	1,85 mio m^3/year
Produced EE from biogas	3.800 MWh/year
Produced digestate	26.400 m^3/year
Liquid part after dehydration	~ 68 m^3/day

Termophilic biogas plant KOTO

Demonstration Center



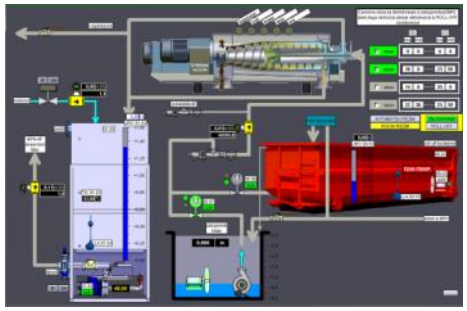



Demonstration Center – Control & Instrumentation



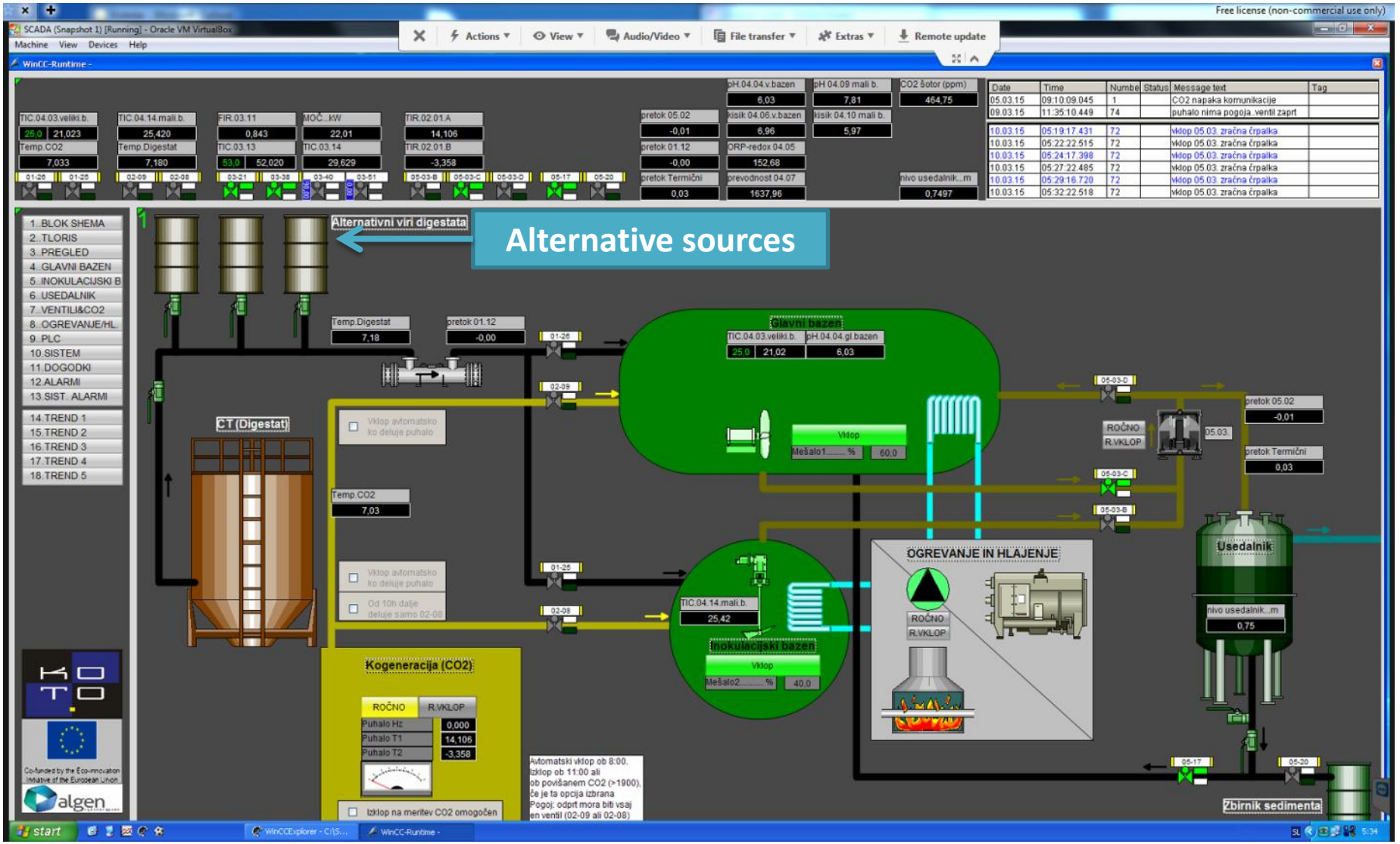




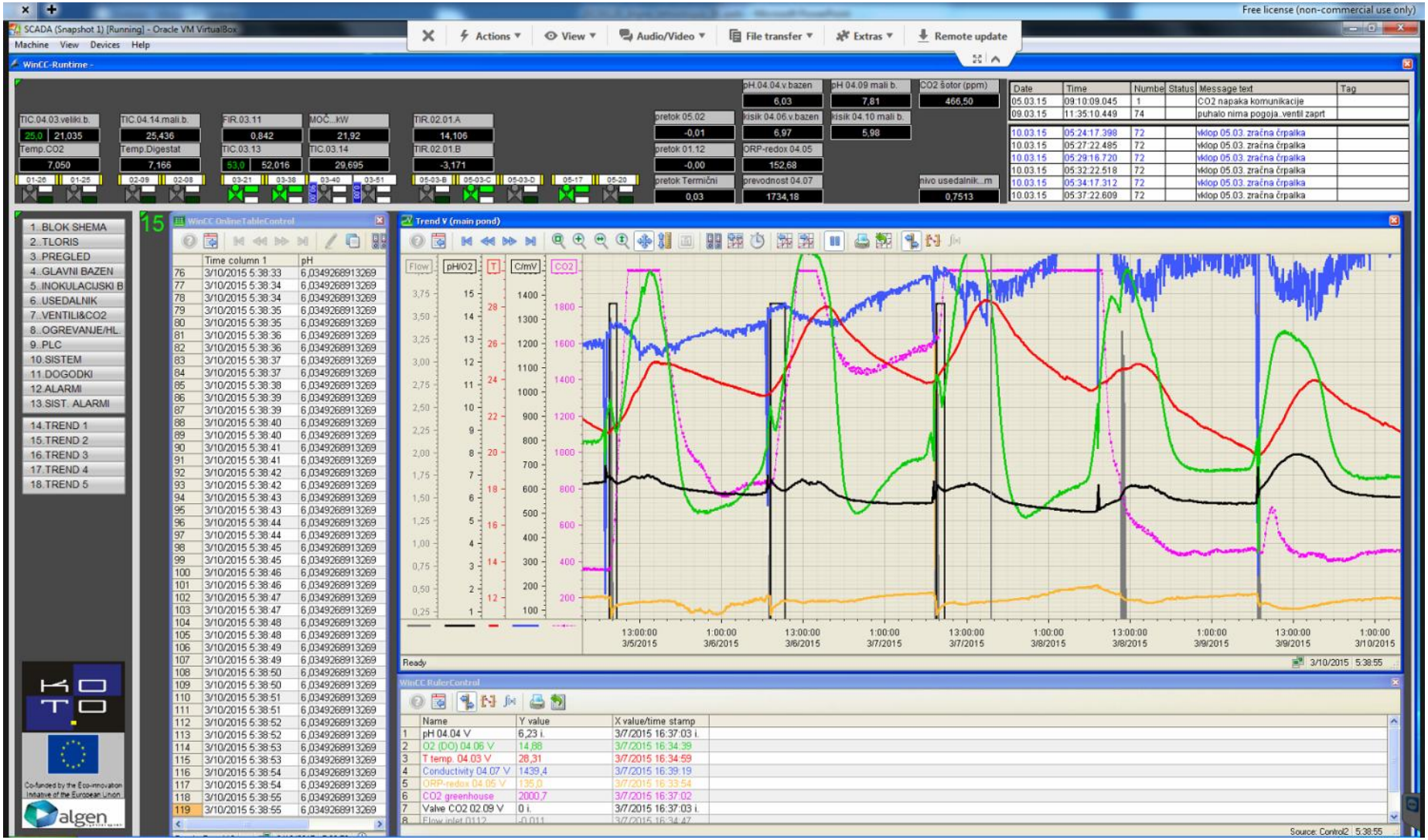



Digestate Preparation

Demonstration Center - Control System



Demonstration Center – Data Collection (preliminary results)



Results

- We are raising the load of biogas digestate in the process
- Monitoring the parameters
- LCA
- Monitoring biomass production and microalgae species
- Testing application potential of produced biomass (feed, fertilizer, bioplastic, biogas production…)
- Development and optimization of the process and technical equipment for large scale installation

- **Partners**: marketing & implementation service
- **Ready for second replication (at an early-adopter site - challenge us)**

Thank you for your attention

Welcome to visit the ABG demonstration centre in Ljubljana, Slovenia

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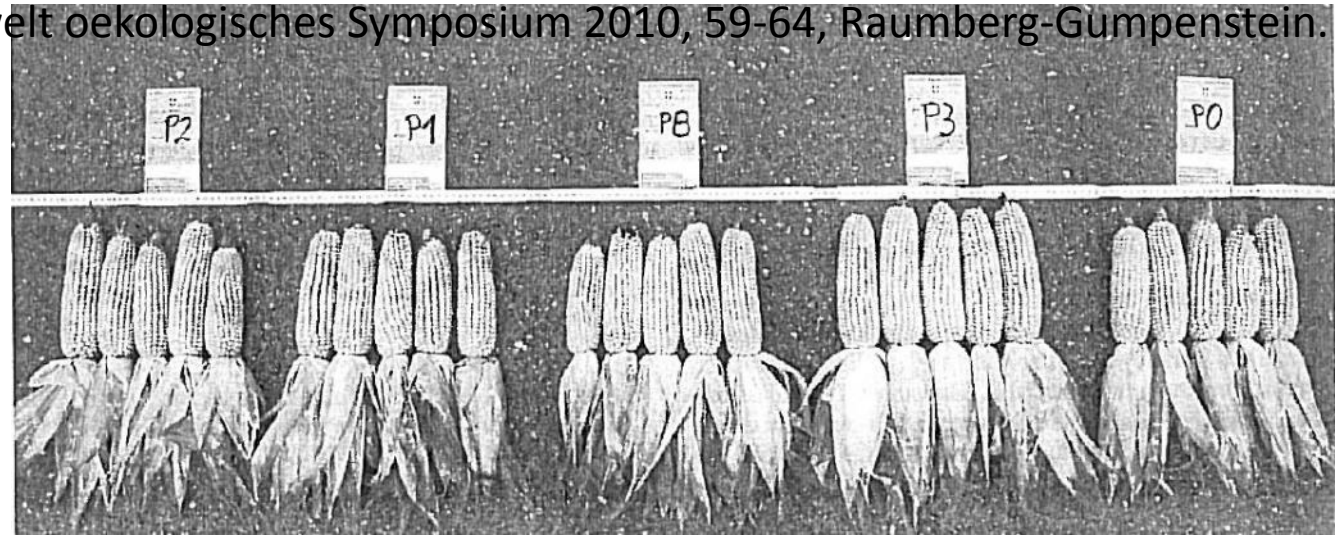
Future

- Preparation for market replication
- Life Cycle Assessment
- Legislation analysis, marketing, partners
- Complementary technologies:
  - Digestate pre-treatment (Algadisk or “Algadisk 2.0” technology)
  - Auto(bio)flocculation
  - ALBA biomass pre-treatment for biogas
  - Animal feed trials (fish, chicken)
- Technical & manufacturing
  - More cost-effective
  - Better performance
  - More control
- **Partners**: marketing & implementation service
- **Ready for second replication (at an early-adopter site - challenge us)**

Unterfrauner, 2010

- 40 weeks trial, 50 m^3/ha
- Application of biogas fermentation residues can adversely affect soil fertility
- High content of free K ions -> acidification, overloading of the sorption complex, destruction of the aggregates
- Addition of $CaCO_3$, $MgCO_3$, $CaSO_4$, Al silicate improved the results significantly
- Unterfrauner, H, et al. 2010, *Auswirkung von Biogasguelle auf Bodenparameter*, 2. Umwelt oekologisches Symposium 2010, 59-64, Raumberg-Gumpenstein.



Digestate separation

1MWe model case

Digestate

80-100 m^3/day
30.000 m^3/yr

Liquid phase (centrate)

65-90 m^3/day

Solid phase

5- 20 m^3/day
6000 m^3/yr

Volume 80-95%

Biological treatment (anaerobic / aerobic)

- Loss of nutrients
- High energy consumption

Environment

Sludge

Fertilizer (Incineration if waste)

Volume 5-20%

- Simpler and less costly logistics (storage, transport, spreading)
- Existing spreading technology
- Mixing with other components (adjusted nutritional and soil conditioning value)