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Harvesting technologies for reeds in Austria

Reed as a Renewable Resource 2013; Greifswald

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The Austrian R&D-Project ENEREED

ENEREED: "Sustainable Energy Conversion from Reed Biomass", aims at the energetic utilization of the reed belt around the Lake Neusiedl

Other presentations of the Project ENEREED in the later afternoon:

- Jürgen Krail: Project overview
- Doris Rixrath: Live Cycle Assessment

My topics are:

- Description of the applied harvesting technologies
- Experiences and performances of harvesting tests to provide 250 t of reed to enable large scale combustion tests at a cement factory
- Improvements and requirements for a new harvesting technology

The Lake Neusiedl

Figure 1: The Lake Neusiedl (google maps)

Potential for the utilization of reed

Table 1: Potential for the utilization of reed in Austria

Potential at the Lake Neusiedl, in Austria		
Area of the reed belt, Austria	18,000	*ha*
Useable reed stock	84,000	*t Reed*
Assumption of a 4-year harvesting turnover	21,000	*t Reed/year*
Fuel oil equivalent	9,350	*t Oil/year*
Equivalent of CO_2 savings, rough estimation (credits of burning fuel oil)	29,000	*t* CO_2*/year*

Technical data of the two considered harvesting machines

Table 2: Technical data of the two considered harvesting machines

Technical data:		**Paul I**	**Sumo-Quaxi**
Type		reaper-binder	reaper-baler
Manufacturer		Erwin Sumalowitsch, Podersdorf	
Year of construction		~2000	2004
Crew	*men*	5	1 … 2
Weight empty / maximum	*kg*	4500 / 6500	9800 / 11500
Maximum soil pressure	*kg/cm²*	0.10	0.12
Overall length * width * height	*m*	6.80*3.00*2.85	9.43*3.10*3.67
Power of Diesel-engine	*kW*	118	142
Fuel consumption	*litre/h*	6.3	10.0
Feed width of mower	*m*	2.85	2.85
Shape of harvested reed		bundles	round bales
Storage capacity = harvest per route	*kg/route*	1850	764

“Paul I” harvester for young grown reed harvesting

Figure 2: “Paul I” harvester for young grown reed harvesting; harvesting on ice in February 2012

“Sumo-Quaxi” harvester for fully grown reed harvesting

Figure 3: “Sumo-Quaxi” harvester for fully grown reed harvesting, during the harvesting operation in March 2012

“Sumo-Quaxi” at the discharging place

Figure 4: “Sumo-Quaxi” has reached the discharging place,
3 bales are dumped, the 4th bale is still in the bale press

GPS-monitored harvesting route

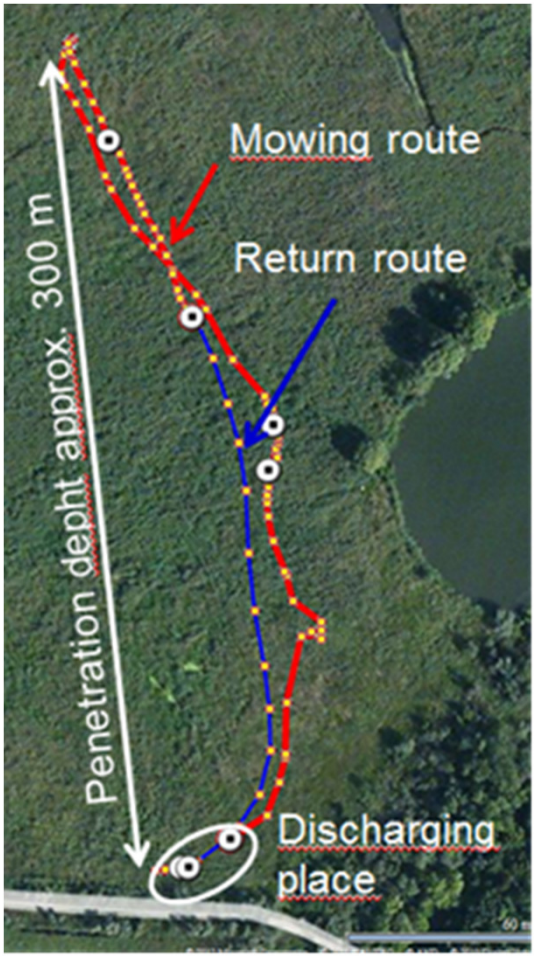

Figure 5: GPS-monitored harvesting route of the "Sumo-Quaxi"

Harvesting route of the "Sumo-Quaxi":

- with a predominate mowing route
- a short return route
- resulting in a penetration depth of 300 m

Performance data - harvesting machines

Table 3: Performance data of the harvesting machines

Performance data (mean values):		**Paul I**	**Sumo-Quaxi**	Measuring Method
Tests at Podersdorf, on March, .., 2012		12th	13th,15th,16th	
Harvest per route	*kg/route*	1850	764	Conventional
Duration of total route	*h/route*	1,33	0,69	Conventional
Hourly harvesting output (wet base)	***t /h***	**1,39**	**1,11**	Conventional
Daily harvesting output (8h/d, wet base)	***t /d***	**11,13**	**8,86**	Conventional
Duration of mowing / discharge	*h*	1,00 / 0,05	0,55 / 0,041	GPS
Distance of mowing / of total route	*m*	1180 / 2260	431 / 690	GPS
Speed, during mowing / without mowing	*km/h*	1,2 / 3,8	0,8 / 2,7 *(+/- 25/40 %)*	GPS
Penetration depth (=Distance of route/2)	*m*	1130	345	GPS
Feed width of mower (see: technical data)	*m*	2,85	2,85	
Mowing performance	*ha/route*	0,336	0,123	
Surface related yield (wet base)	*t/ha*	5,5	6,2	

Predicted harvesting output - "Sumo-Quaxi"

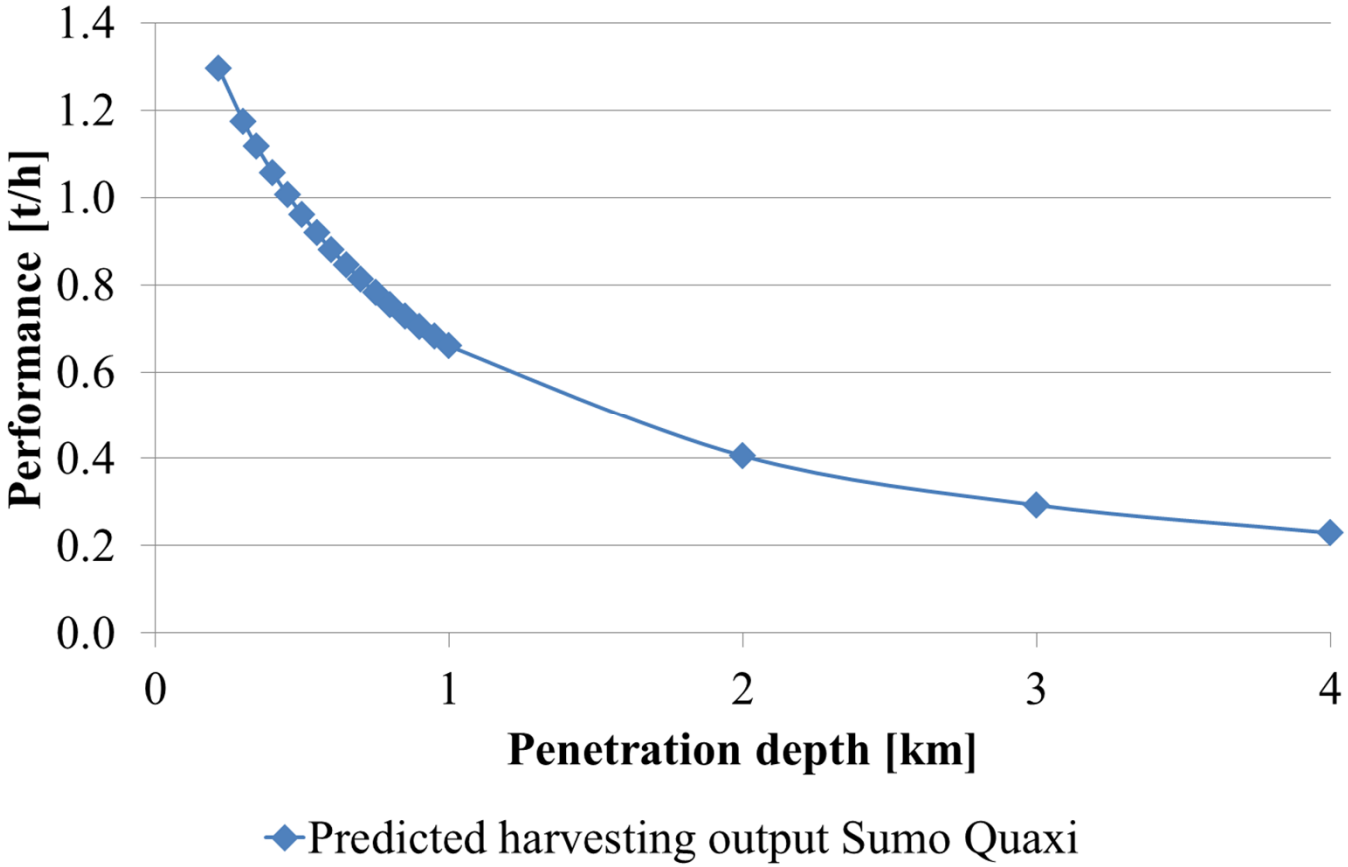

Figure 6: Predicted harvesting output [t/h] of the "Sumo-Quaxi" as a function of the required penetration depth [km], (optimum: 1.3 t/h at 0.215 km)

Storage-relevant data

Table 4: Some storage-relevant data for different shapes of reed

Shape of the reed		***Chipped***	***Round bales***
Pressing process		cutting	wrapped
Size	*m*	<0.1	1,2 * 1,2
Volume	*m³*		1,357
Weight	*kg*		191
Density	*kg/m³*	120	140,8
Pile-ability		heaps, no piles	limitated
Formation of piles		no piles	staggered
Storing place		roofed	open air
Relative storage costs*	%	340 %	"100 %"

*) Hartmann 1996

Chipping and Transporting

Chipping, with commercially available chippers:

- up to 600 HP Diesel-engine power,
- up to 65 litre/h fuel consumption,
- up to 11 t/h reed throughput.

Transporting; with conventional trucks, with trailers:

- with 90 m^3 - containers,
- approximately 11 t of reed per container.

The chopping machine

Figure 7: The chipper, driven by a tractor via a transmission shaft, fills the top-open container of the truck; considerable development of dust (May 2012)

Skipping and discharging

Figure 8: Skipping and discharging the chipped reed at the storage bin of the cement factory

Possible improvements and requirement for a new harvesting machine

The given technologies are, in principle, feasible, but further ***incremental*** improvements are necessary to increase the output an the annual utilisation (the key factors for any economic achievement):

- an increase of mean velocities enhance output
- an larger feed width increases output, too
- an increase of bale density and capacity shortens the duration of the return route
- shuttles save the necessity of the return route
- beside harvesting operation, chipping and fuel consumption cause considerable costs.

Fundamental improvements, however, call for new harvesting designs and probably for new concepts. The Austrian company Schuch GmbH (activities: landscape preservation and gardening, mowing, chipping, transport) has contribute to create a new harvest concept.

Contact Research Partners

Research Partners

Fachhochschul Studiengänge Burgenland
Project Management
Industrial Conversion
Thermal Conversion Small Scale

TU WIEN Technische Universität Wien Vienna University of Technology
Inst. f. Verfahrenstechnik, Umwelttechnik und Techn. Biowissenschaften
Thermal Conversion Large Scale

Technisches Büro für Maschinenbau und Energietechnik Dr. Georg Beckmann
Harvesting Technology

Cooperation Partners

Cultivation, Fuel Supply and Fuel Processing

Amt der Burgenländischen Landesregierung
Cultivation,
Fuel Supply

Esterházy
Land Owner,
Cultivation

WWF
Environmental Protection,
Sustainable Cultivation

Conversion

LAFARGE ZEMENT
Industrial Conversion

Herz
Thermal Conversion
Small Scale Plant

Biomasse Fernheizwerk Güssing
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klima+ energie fonds