PALUDI CULTURE

GREIFSWALD

The Review of the results of performed EU projects on reed and meadow grasses in Estonia and Finland

Ülo Kask, et al.

Renewable Resources from Wet and Rewetted Peatlands 2017.

RRR Conference Greifswald, 26-28. September 2017.

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  - Reed bed biodiversity,
  - Traditional use of reed,
  - Handicraft and fine art,
  - Physical and chemical characteristics of reed as biofuel,
  - Untraditional use of reed – bioenergy, construction (complex roofs, walls, plates, blocks etc.).
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Authors of the Presentation

- **Ülo Kask**, MSc, corresponding author, The Estonian Biomass Association – resource analyses, biomass characteristics
- **Siim Link**, PhD, Tallinn University of Technology – biomass combustion
- **Arvo Iital**, PhD, Tallinn University of Technology – water protection, environment
- **Iiro Ikonen**, PhD, ELY-centre for Southwest Finland, biodiversity, environment protection
- **Ülo Mander**, PhD, University of Tartu – biodiversity, hydro systems
- **Martin Maddison**, PhD, University of Tartu – biodiversity
- **Jaan Miljan**, PhD, Estonian University of Life Sciences - building

Introduction

- A number of EU funded projects in Estonia and Finland (and other partner countries too) have performed to build good practice and facilitate knowledge exchange on related issues of Common Reed (*Phragmites australis (Cav.) Trin. Ex Steud*), largely at regional scales.
- The reed work should be aimed at synergy between the cutting of reed beds for biodiversity and water protection and the local and regional solutions for harvesting of reeds for biomass fuel, construction material, soil improvement and for other needs.


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Phragmites communis Trinius.
Gemeines Schilfrohr.
A
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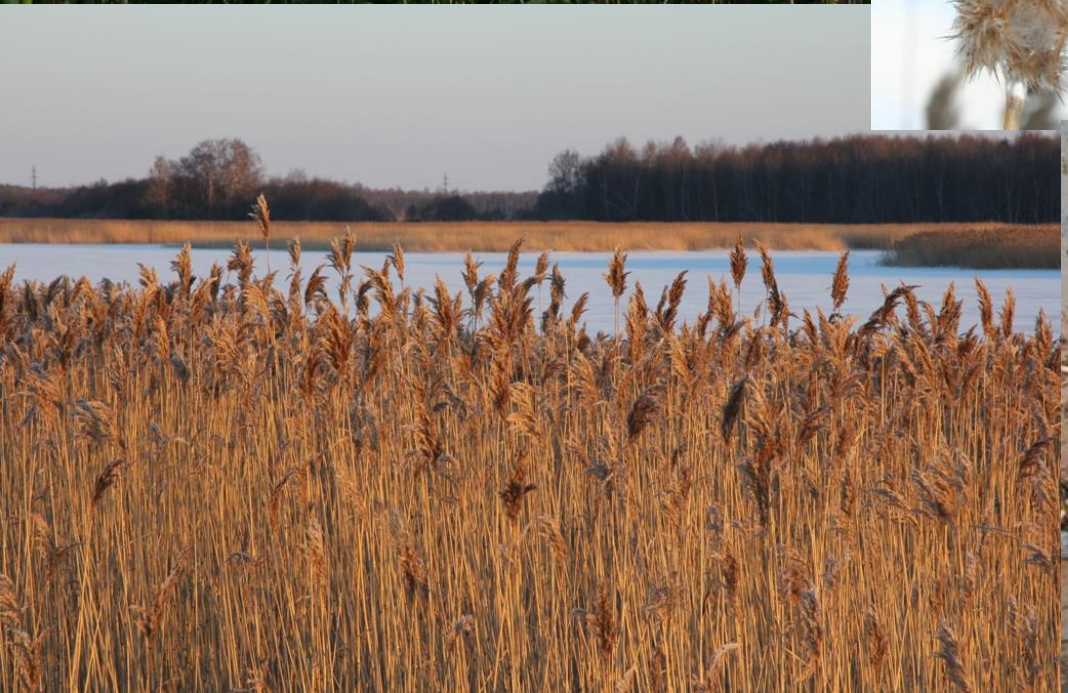
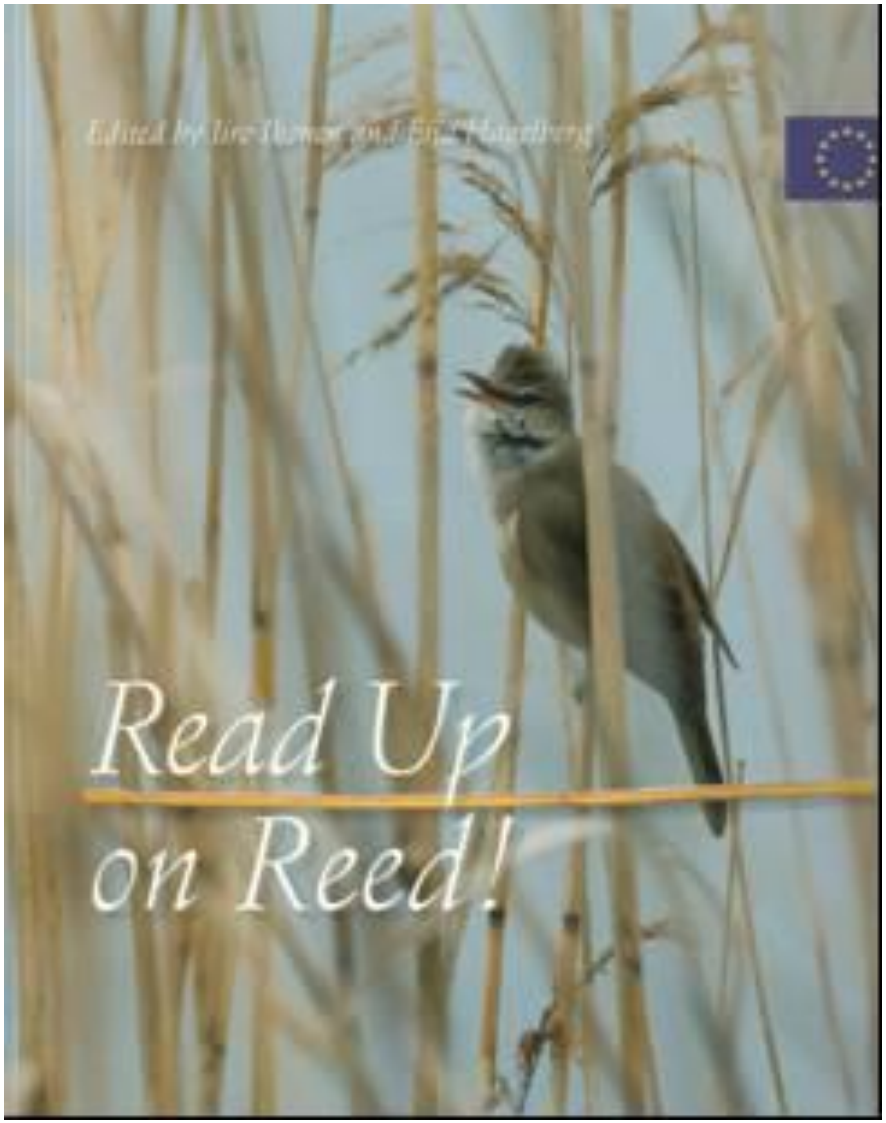


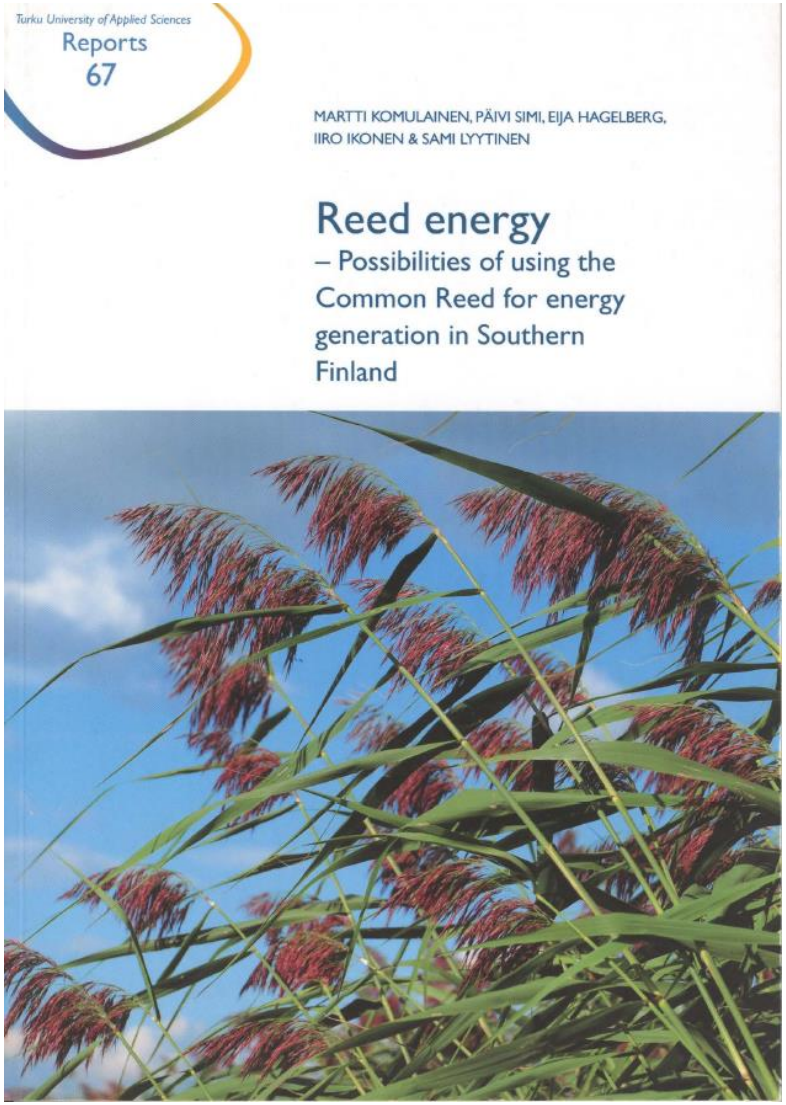
List of EU co-funded projects

Below is a list of main EU projects in which the authors have participated and some outputs:

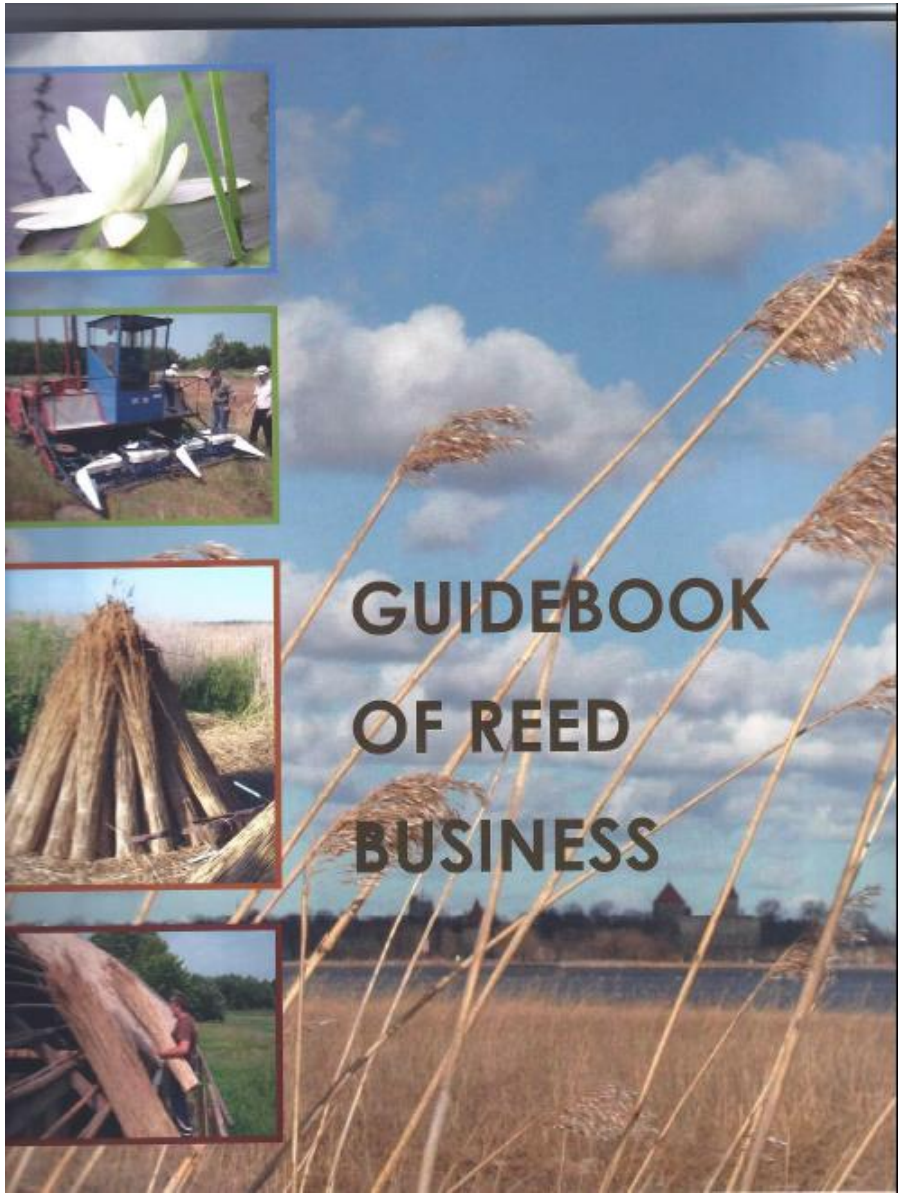
- Interdisciplinary INTERREG IIIA project ”Reed strategy in Finland and Estonia”, 2005-2007, produced several practical publications connected with sustainable planning and use of reed (Read up on Reed!, Reed Energy, Reed Construction in the Baltic Sea region, local strategies for using reed beds etc) – Finland, Estonia.
- INTERREG IVA project COFREEN ”Concepts for using reed biomass as local bioenergy and building material”, 2010-2013, produced e.g. a Guidebook of Reed Business, Reed for Bioenergy and Construction + video film – Finland, Estonia, Latvia
- The European Agri-project VELHO, 2010-2014, carried out by ELY Centre in Southwest Finland introduced guide for multi-purpose planning of Finnish coastal areas.
- INTERREG IVB BSR Programme project SUBMARINER „An Assessment of innovative and Sustainable Uses of the Baltic Marine Resources“, including common reed, 2010-2013, produced The Submariner Compendium and Roadmap, regional strategies – Poland, Germany, Denmark, Sweden, Estonia, Lithuania, Latvia, Finland.
- Estonian Research Council grant PUTJD566. 2016-2017.

Examples of publications



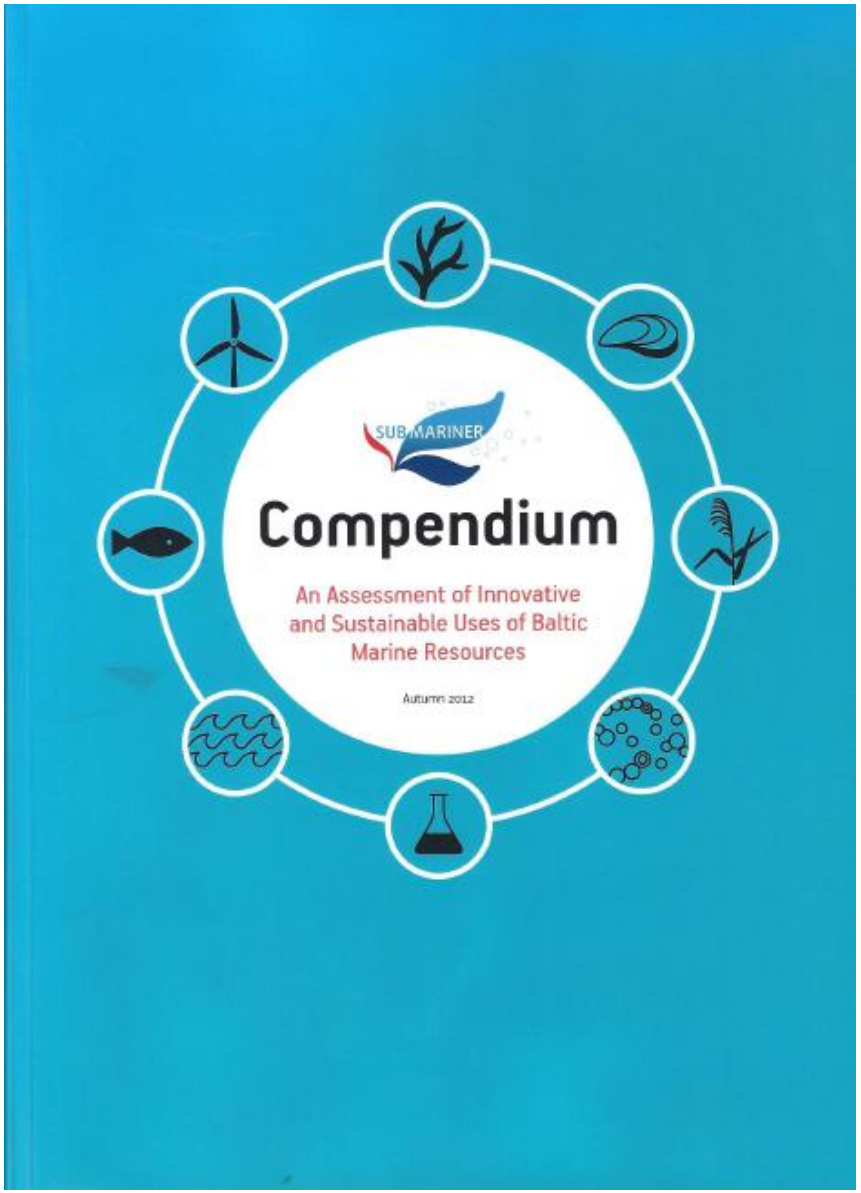


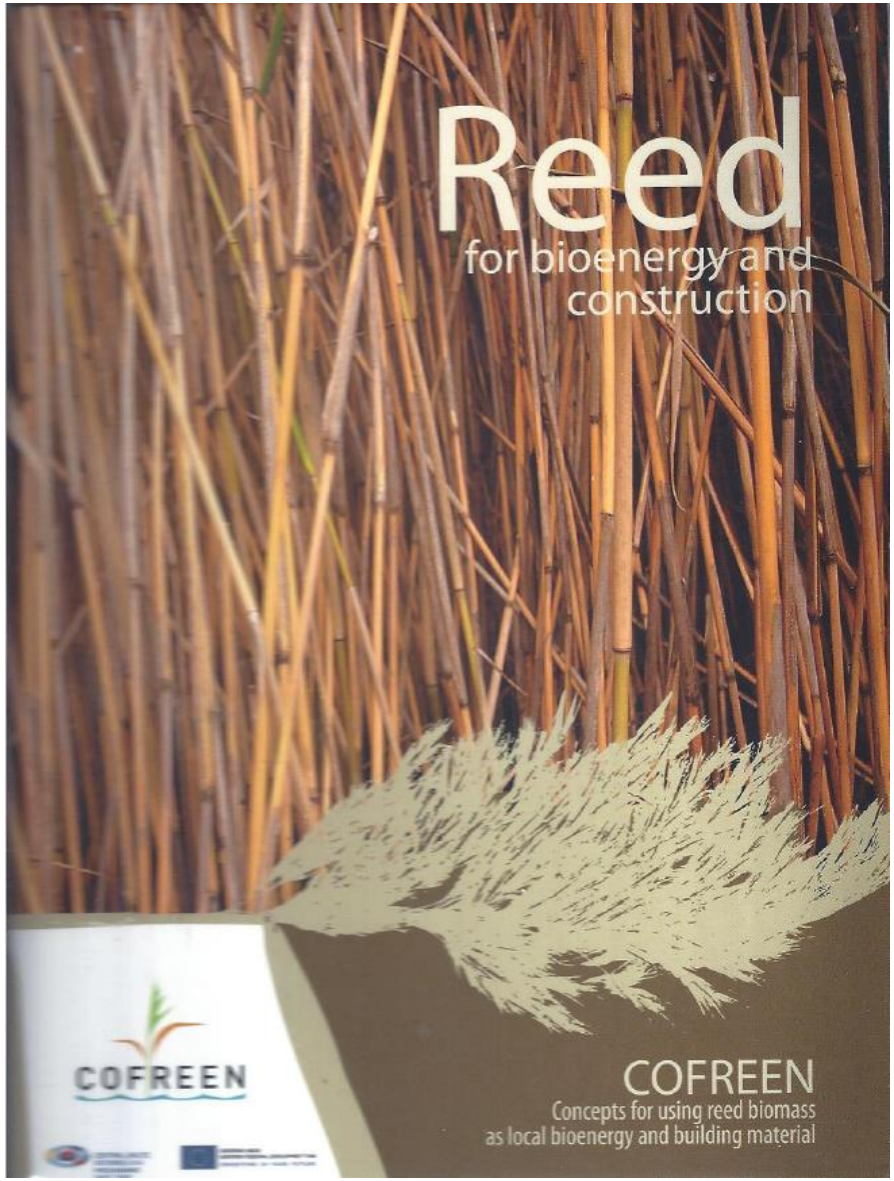
Examples of publications



Reed Strategy in Väinameri Region 2008-2018

Examples of publications

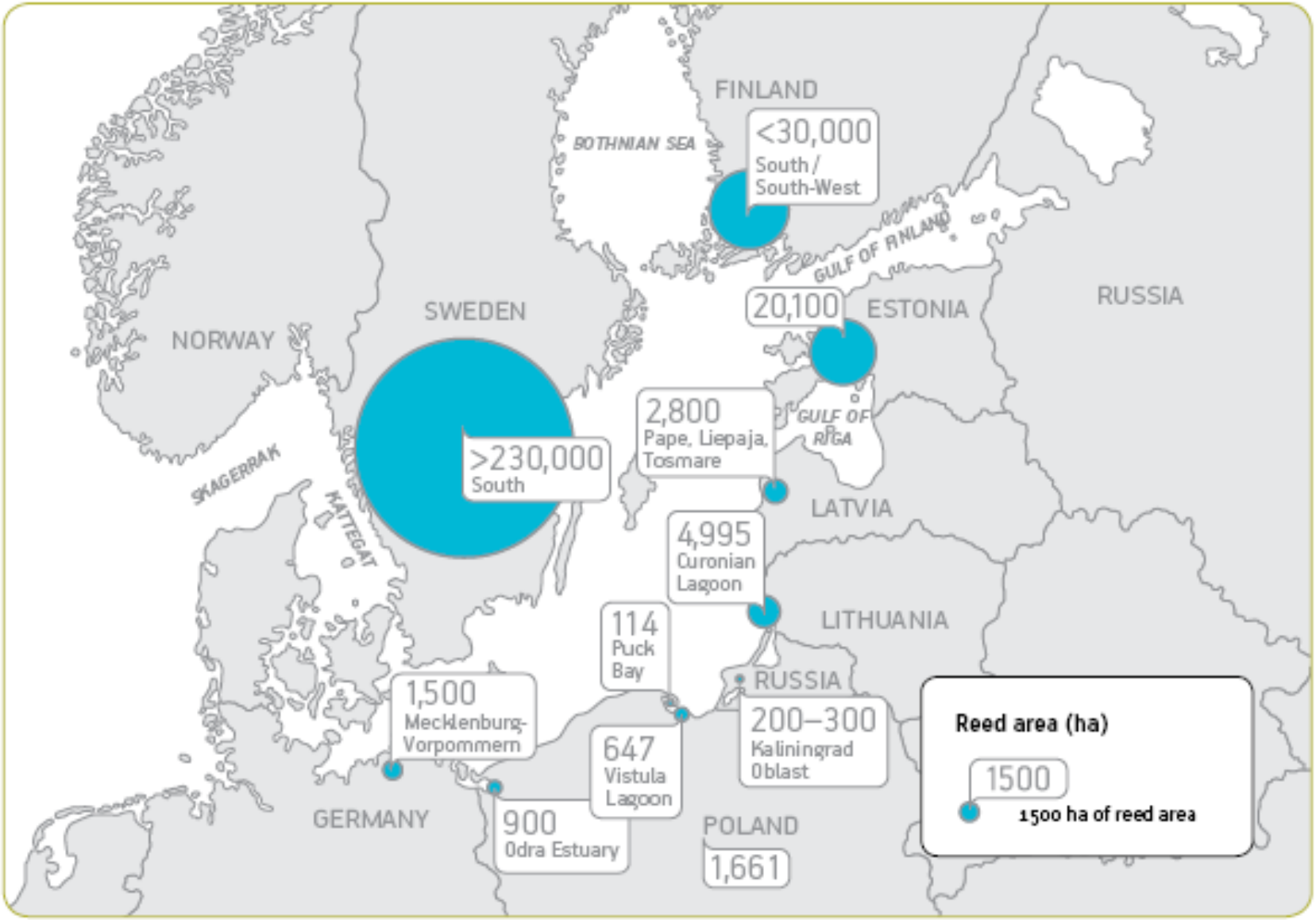




The main topics to be addressed in the projects

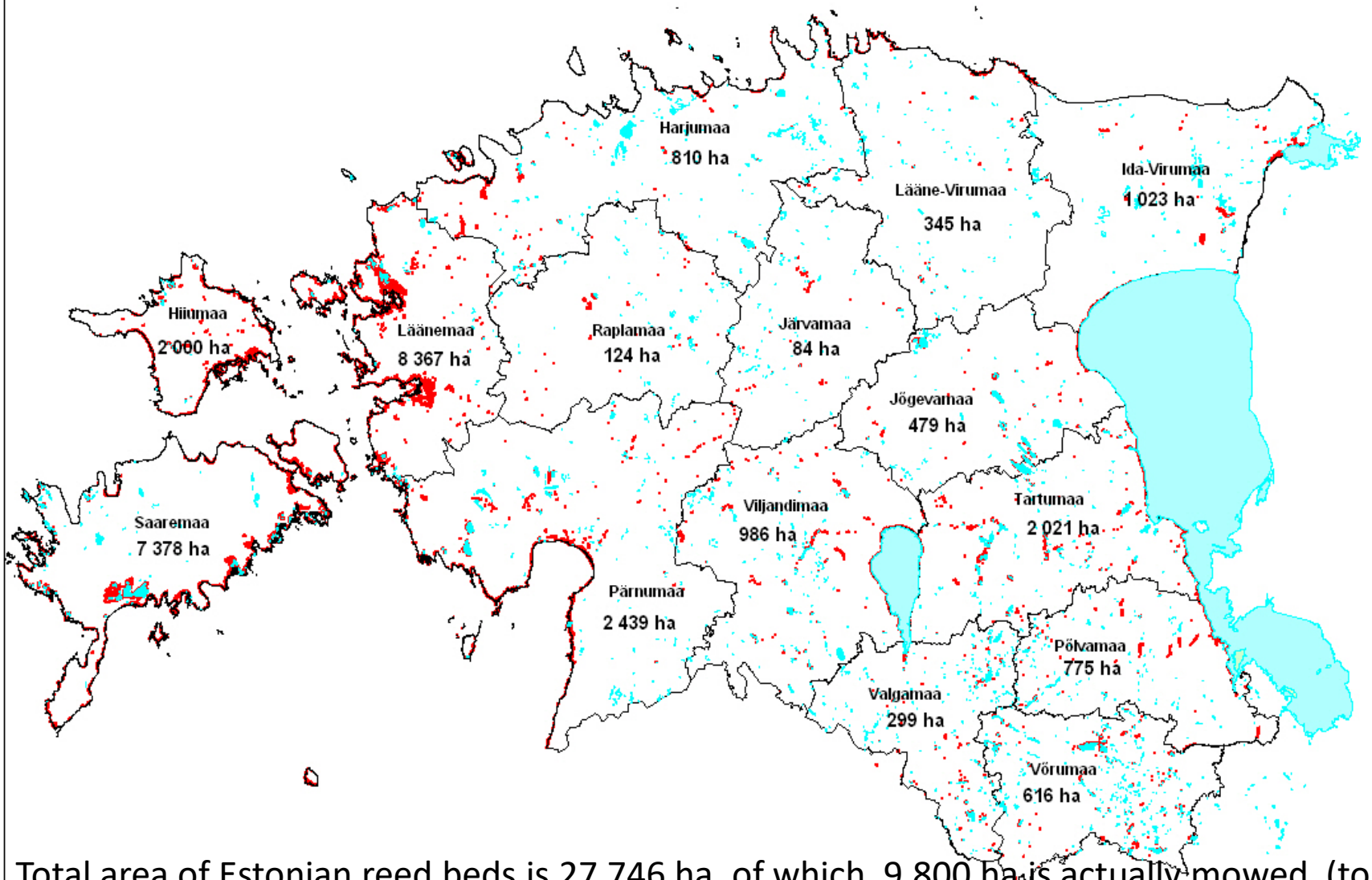
- Reed resources and reed bed mapping
- Reed bed development and use, strategical planning
- Reed mowing and water quality
- Restoration of coastal meadows
- Reed bed biodiversity
- Traditional use of reed – building (thatching, insulating material), cattle fodder
- Handicraft and fine art
- Physical and chemical characteristics of reed as biofuel
- Untraditional use of reed – bioenergy (pellets, biogas, liquid biofuels), construction (complex roofs, walls, plates, blocks etc)

Resources of Reed in Baltic Sea Region



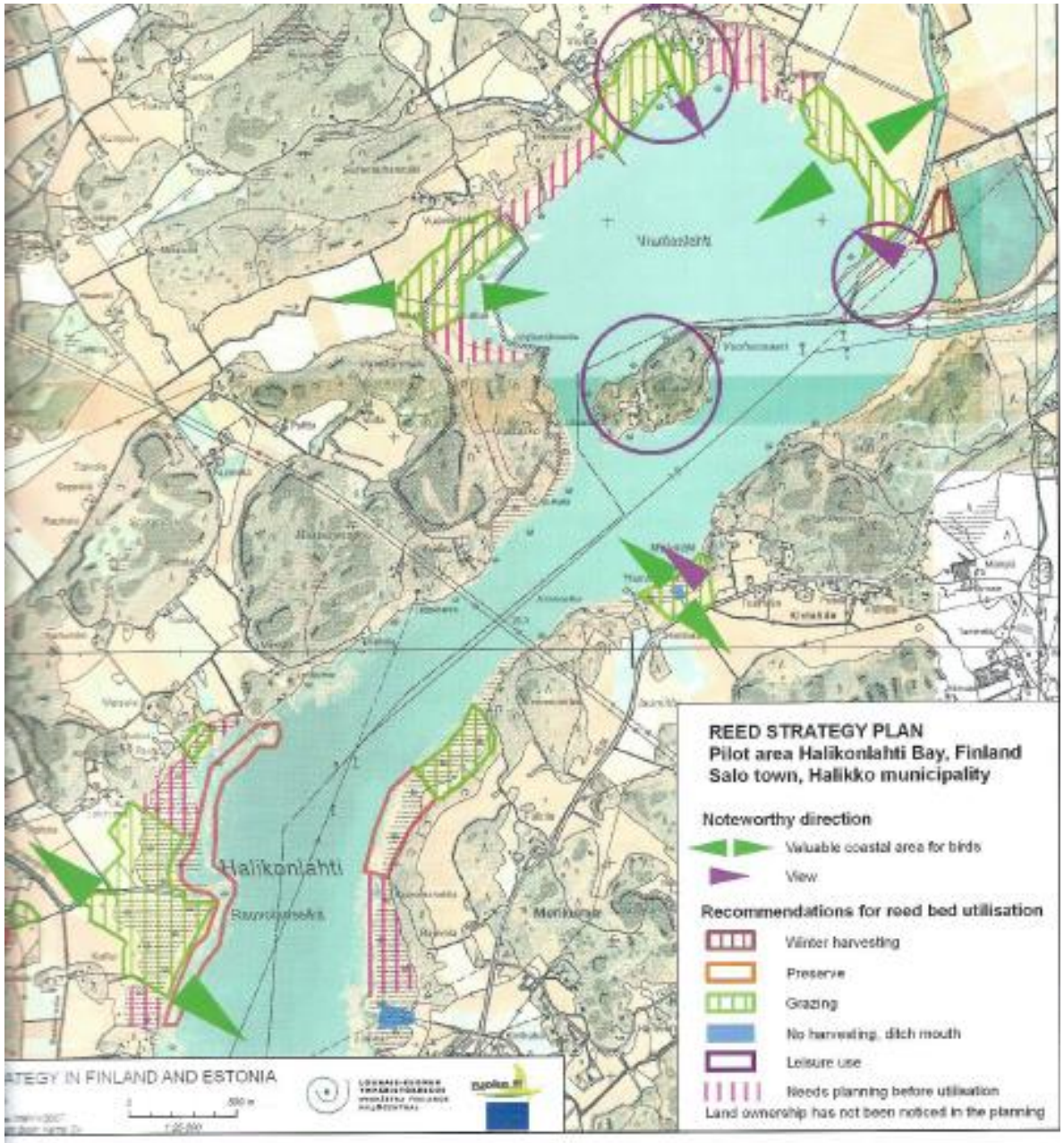
Source: Arvo Iital, Marija Klõga ,Ülo Kask, Viktoria Voronova & Bronwyn Cahill (2012). Reed Harvesting. Compendium - An Assessment of Innovative and Sustainable Uses of Baltic Marine Resources. Maritime Institute in Gdańsk. 2012. pp. 103-123.

Reed resources and location in Estonia



Total area of Estonian reed beds is 27 746 ha, of which 9 800 ha is actually mowed (to ensure sustainability, restrictions, all red beds not fully covered by reed etc. It is estimated that **yearly harvestable energy content of reed is approximately 255 GWh**. 2008.

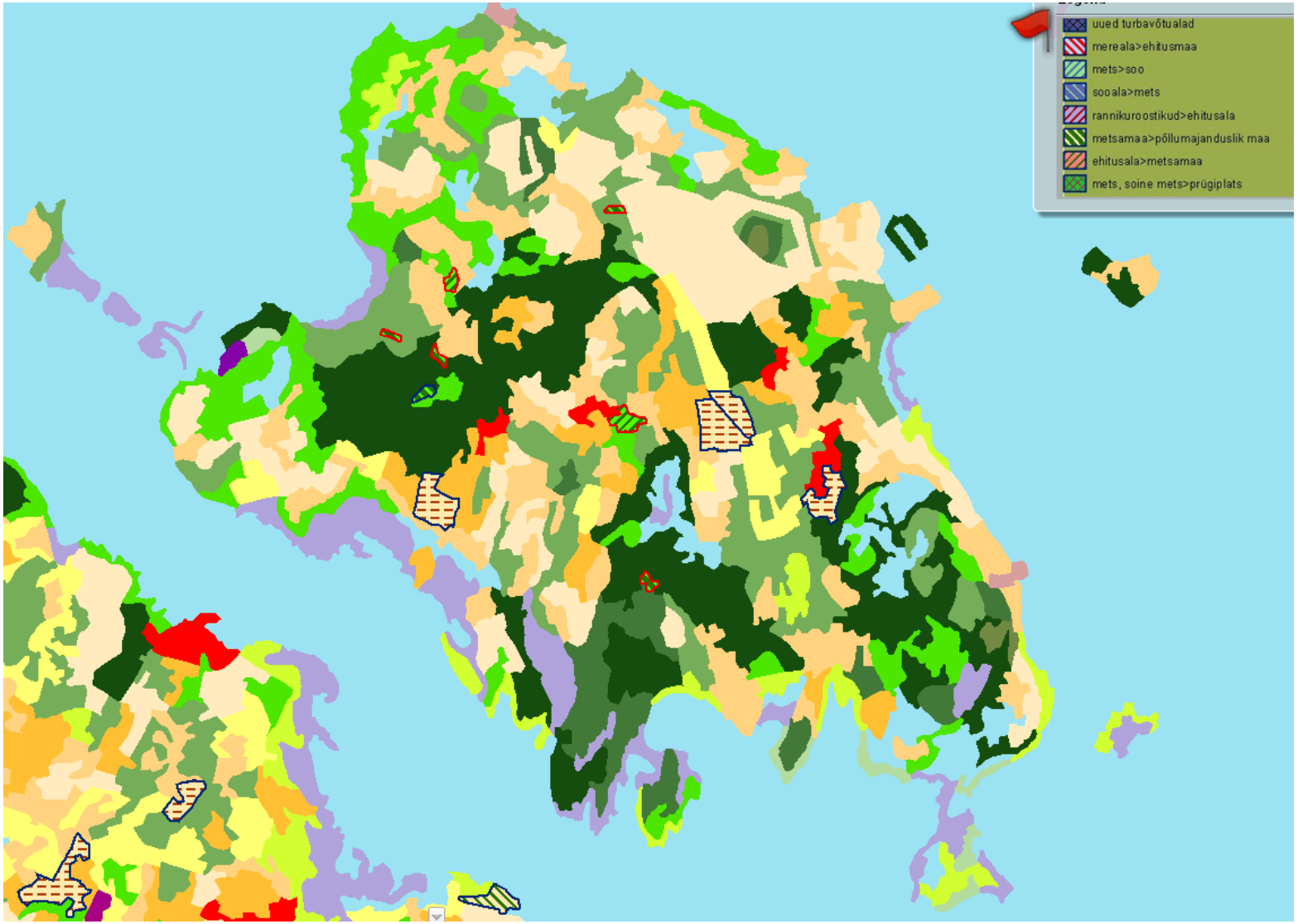
Strategical planning



...egy map of Halikonlahti Bay, in the municipalities of Salo and Halikko, Finland. Map: Eija Hagelberg.

- Different areas for reed using is determined – preserve, winter harvesting, grazing , leisure use, no harvesting, ditch mouth, needs planning before utilisation,
- Valuable area for birds and other animals
- Grand views

Reed beds of Muhu island (violet) and other land resource (Estonia)



Reed mowing and water quality

Key recommendations

- The removal of reed must always be carried out with care.
- The overall effects of reed on water quality cannot always be predicted (many impacts are indirect).
- Cutting of reed can increase the growth of other aquatic macrophyte species and thus diversify the habitats of zooplankton and fish.
- Mosaic and channel cutting of large reed beds is useful in general and doesn’t increase the nutrient release from the sediments.
- Shoot cutting should always be done below water level, if the aim is to stop reed growth completely.
- It is advisable not to remove reed between fields and wetlands or along ditches and river estuaries (can increase the amount of nutrient flow to into water ecosystem, eutrophication enhances.
- Mowing of reed have substantial effects on greenhouse gas emission, false management may increase the emission.

Reed mowing and water quality

- There are two benefits to winter harvesting:
- The decomposing, oxygen–consuming biomass is removed, which improved water quality
- The reed itself can serve as raw material for building and, bioenergy and as mulch in gardens
- Without winter harvesting reed rafts drift ashore

In early summer (June) there are lot of nutrients in the stem and the leaves of reed, which makes it a nutritious and delicious food of cattle (fodder).

Early summer cutting is the most effective way of eliminating the reed.

Restoration of coastal meadows

- One of the main goal's of Lintulahdet Life project (2003-2007) was to restore a more diverse and representative flora instead of the food-plain reed beds and near-extinct coastal meadows (160 ha).
- This project achieved excellent results by restoring the meadows that had turned to reed beds. The meadows became an important resting place for several species in migratory period.
- Positive changes have also been observed in the number of nesting birds.
- The small pools in reed beds offer a good habitat for the breeding of adult Large White-face Darters and excellent protection against predatory fish for their larvae.
- Reed is removed permanently from coastal meadow after 5-10 years of active cutting and grazing.

Restored Elfik meadow in Laajalahti, Finland

The rootstock of a reed bed growing at the water’s edge can be broken by driving over it with a lorry on caterpillar tracks, Caterpillar tracks can be seen clearly at the water’s edge.

Reed bed biodiversity

- Management by mowing or burning reduce over-wintering animal populations on or inside the reed. Unfortunately, this also affects birds in the reed bed.
- In northern Europe, a core group of five species are completely dependent on the reed beds for both nesting and foraging, i.e. bittern, Bearded Tit, Reed Warbler, Great Reed Warbler and Water Rail.
- But aquatic insects are also an important and easily available food source when the juvenile stages emerge as adults above the water.
- Both the abundance and diversity of bird species can be expected to be highest at the edges of flooded reed beds. Especially edges towards open water.

A reed bed designed to suit all species

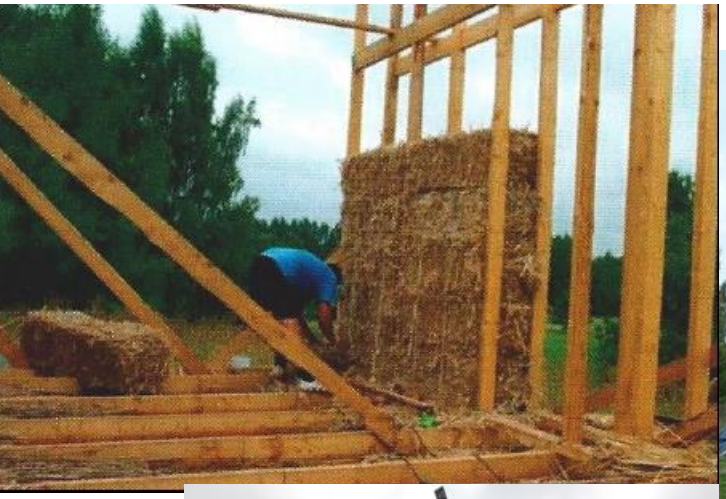
Painting: Elen Apsalon.

Traditional use of reed – building
(thatching, insulating material)

Fisherman's shelter

Estonian old farmhouses – Inside insulation of the room

Reed as construction material



Reed as construction material

- Main tests carried out in projects:
  - Determination of thermal conductivity of reed plates,
  - Thermal transmittance of wall fragments insulated with reed,
  - Thermal transmittance of enclosures of test house made from wood and reed,
  - Mould test,
  - Fire tests of thatched roof.

Handicraft and fine art

Physical and chemical characteristics of reed as biofuel

Element	Ranges		Average	
	Winter	Summer	Winter	Summer
Carbon, C	46,96–48,34	46,13–47,11	47,5	46,5
Hydrogen, H	5,50–5,60	5,93–6,42	5,6	6,2
Oxygen, O	42,75–43,84	39,7–42,2	43,3	40,7
Nitrogen, N	0,23–0,34	0,57–1,17	0,3	1,0
Sulphur, S	0,03–0,09	0,12–0,45	0,04	0,2
Chlorine, Cl	0,05–0,18	0,28–0,48	0,1	0,4

Elemental composition of dry reed fuel, %

Characteristics vary to some extent depending both on the site of growth (on the shore of sea or lake, river deltas, wetland treatment systems) and seasonally (harvested either in summer or winter).

Fuel source	Combustible matter, %				
	C^p	H^p	S^p	N^p	O^p
Lake reed	46-48	6-8	0,02-0,2	0,24-1,32	37-47
Seashore reed	46-48	6-8	0,01-0,3	0,23-1,81	37-47
Peat	55-60	6-7	0,4-0,6	2-3	30-35
Wood	50-55	6-7	0,05	0,5	40-45

Some physical characteristics

Parameters: Calorific value, MJ/kg Energy content, MWh/t	Ranges		Average	
	Winter	Summer	Winter	Summer
$Q_p/q_{b,}$	18,62–19,16	18,33–18,77	18,92	18,51
$Q_ü^k/q_{gr,\ d}$	18,62–19,16	18,31–18,75	18,91	18,49
$Q_a^k/q_{net,\ d}$	17,48–18,01	17,02–17,44	17,77	17,21
$Q_a^{20}/q_{net,\ 20}$ *	**13,68–14,86**	**13,16–13,49**	**14,17**	**13,31**
$E^{20}/\ E_{20}$, MWh/t*	**3,80–4,13**	**3,65–3,75**	**3,94**	**3,70**

Heating value of dry matter and at moisture content 20% of reed fuel.

*at moisture content 20 %

The yield and characteristics slightly depend on harvesting period and site of growth of reed.

Main characteristics	Seashore reed		Lake reed	
	Winter	Summer	Winter	Summer
Moisture, %	23,7	60,4	21,1	60,5
Yield of dry matter, t/ha	6,9	8,7	8,1	7,4
Volatile matter, %	82,0	75,7	82,3	77,1
Ash content of dry matter (at 550 ºC), %	3,5	6,3	3,1	5,7
Net calorific value of dry matter, MJ/kg ($Q_a^k/q_{net,\ d}$)	17,5			

Some results of chemical analysis, summer reed

Sample	Dry matter, %	N, %	P, %	K, %	Ca, %	Mg, %	Cellulose, %	Lignine, %	Hemicellulose, %
1.Silma	44,31	0,690	0,087	0,568	0,155	0,036	40,16	6,93	30,63
2.Rocca al Mare	28,40	2,183	0,201	2,029	0,253	0,067	35,50	7,21	27,31
3.Puhtu	41,58	1,103	0,097	0,956	0,176	0,085	39,12	8,38	28,37
4.Jõesuu	38,86	0,889	0,078	0,802	0,230	0,063	34,11	7,15	28,48
5.Puhtu (old)	81,78	0,326	0,028	0,084	0,077	0,023	45,65	12,37	28,48
6.Vaibla	27,03	2,089	0,199	1,733	0,298	0,094	33,44	5,03	28,42
7.Kiideva	41,34	0,872	0,113	0,917	0,104	0,065	39,91	7,94	31,33
8.Haapsalu-Aiavilja	39,46	1,166	0,155	0,953	0,213	0,121	32,93	5,96	31,19
9.Lüübnitsa	32,62	1,842	0,179	1,033	0,256	0,058	35,74	8,01	31,62
10.Turbuneeme	33,89	1,377	0,138	1,170	0,229	0,125	35,10	8,02	31,20
11.Haapsalu-Papiniidu	42,64	1,092	0,146	0,774	0,267	0,106	36,70	9,74	30,31
12.Popovitsa	34,43	1,348	0,146	0,917	0,223	0,084	36,30	7,89	31,11

Chemical composition of reed ash at (550 °C), %

. Component	Ranges		Average	
	Winter	Summer	Winter	Summer
SiO_2	65,34–85,50	25,90–48,33	77,77	37,10
Fe_2O_3	0,13–0,84	0,17–1,69	0,29	0,70
Al_2O_3	0,1–1,69	0,11–1,12	0,57	0,61
CaO	3,07–7,27	4,02–11,53	4,42	6,84
MgO	0,4–1,45	1,87–4,88	1,22	3,33
Na_2O	1,96–9,05	0,87–10,98	3,19	3,61
K_2O	0,99–5,69	14,89–31,33	4,26	24,77
Other	1,57 – 19,4	17,28 – 33,5	8,28	23,04

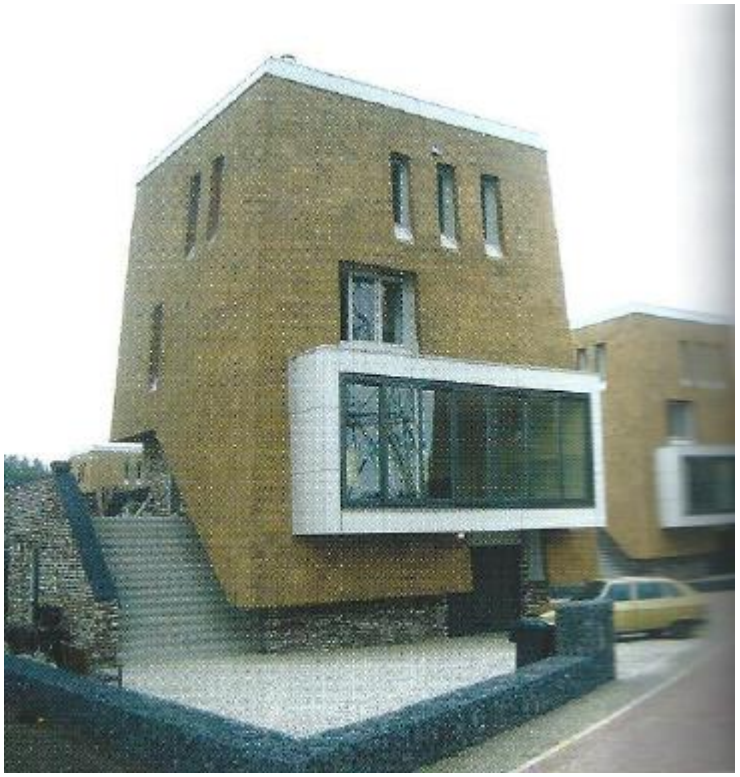
Biogas yield of green reed

Parameter	Only leaves, Peipsi	All plant, Mahu	All plant, Peipsi	All plant, Rocca al Mare
Biogas per dry matter, l/g or m^3/kg	0,428	0,487	0,450	0,533
Biogas per volatiles, l/g or m^3/kg	0,391	0,437	0,417	0,500
Biogas per matter as received, l/g or m^3/kg	0,238	0,149	0,166	0,162

Bio methane potential was in the range of 0.26-0.36 m^3/kg organic material.

Untraditional use of reed – new ways

Construction



Morden houses with reed walls and roofs

Untraditional use of reed – new ways

Bioenergy

Untraditional use of reed – new ways

Bioenergy

Conclusions

- **European countries should give greater attention to reed (and other non-wood) biomass under the *Renewable Energy Directive*** and consider e.g. introducing standards for reed pellets or construction materials.
- **Reed** should also classify **as an agricultural product** and thereby open the possibility of 'direct payments' for reed bed retention and management under the *Common Agricultural Policy*.
- **Should be enhance agri-environment funding for restoration, management and harvesting of reed beds and for the use of cut reed to add organic matters to soils** (as tested by the Reedfield project).
- Management planning for valuable wetland sites, including Natura 2000 sites, is often inadequate or poorly implemented, and **there is potential for greater integration of reed harvesting to benefit both biodiversity and business.**
- Need for system innovations considering the combined effects of reed resource uses and their social and environmental benefits.

- Based on the results of the projects discussed in this report, the authors intend to write a comprehensive overview article.

Photo : Antti Below