Implementation of IFBB to Poland – case study

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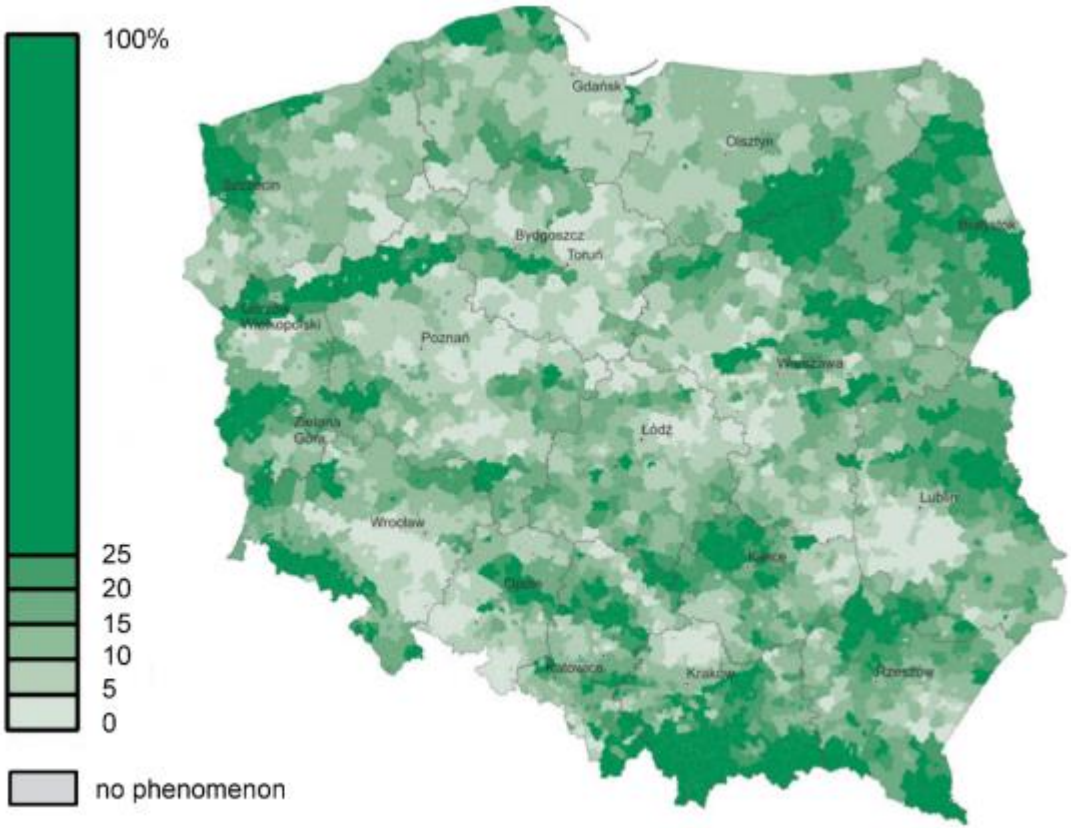
Meadows in Poland



- 2,565,000 ha
- about 66% are semi-natural (11.6% of AUA)
- trend in surface area – decreasing
- conservation status of semi-natural meadow habitats – U1 or U2

Share of meadows in agriculturally utilized area (AUA)

Reasons for the decline of semi-natural grassland area in Poland

Reason	Priority scale (1-highest, 5-lowest)
land/farm abandonment	1.32
low productivity	2.47
lack of agricultural policy	2.94
intensification of use	3.34
disadvantageous management	4.92
$NIR_{0.05}$	0.40

Source: Goliński i Golińska 2011

Reasons for the abandonment of semi-natural grasslands utilisation in Poland

- drop in livestock numbers (sheep – from 4 million to 220 thousand, cattle – from 10 million to 5 million)
- low quality of forage (low digestibility, poor feeding value, low efficiency of forage conversion into animal products)
- concentration of cattle production in particular regions (increase of livestock number per farm)

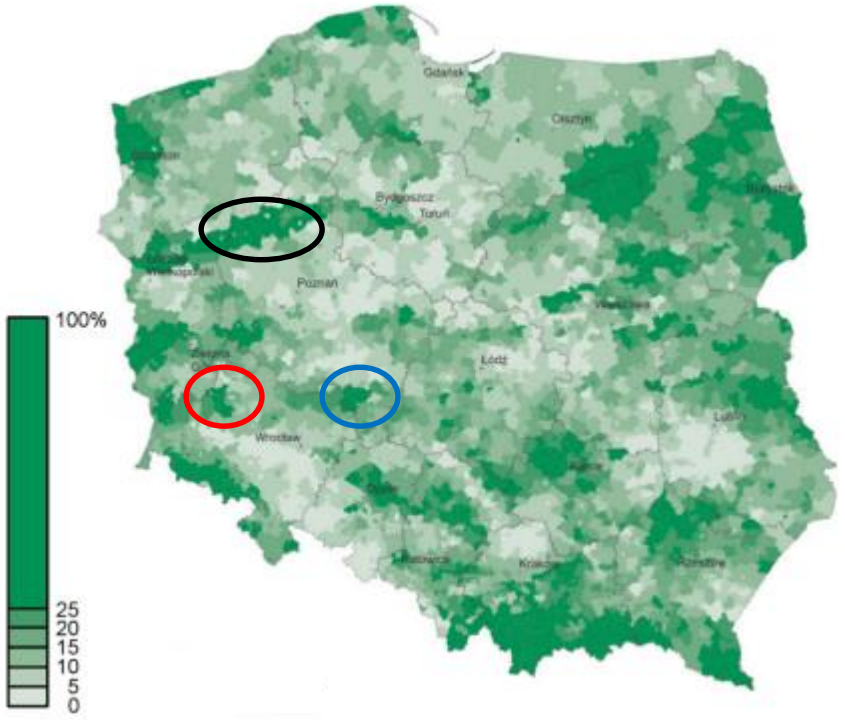
PROGRASS and IFBB in Poland – circumstances of implementation

- capability of biomass production on Polish semi-natural grasslands is significant
- maintenance of this grasslands use is an urgent task of nature conservation in Poland
- main requirement for beneficiaries of schemes created for protection of birds and Natura 2000 habitats regarding use of such areas – late cutting and biomass removal
- the IFBB technology is a chance for preserving semi-natural grasslands

Polish case study – selection of sites and plant communities

Vegetation of selected sites:

- *Phalaris arundinacea* dominated community
- *Phragmitetum australis*
- Tall-sedge community dominated by *Carex riparia*

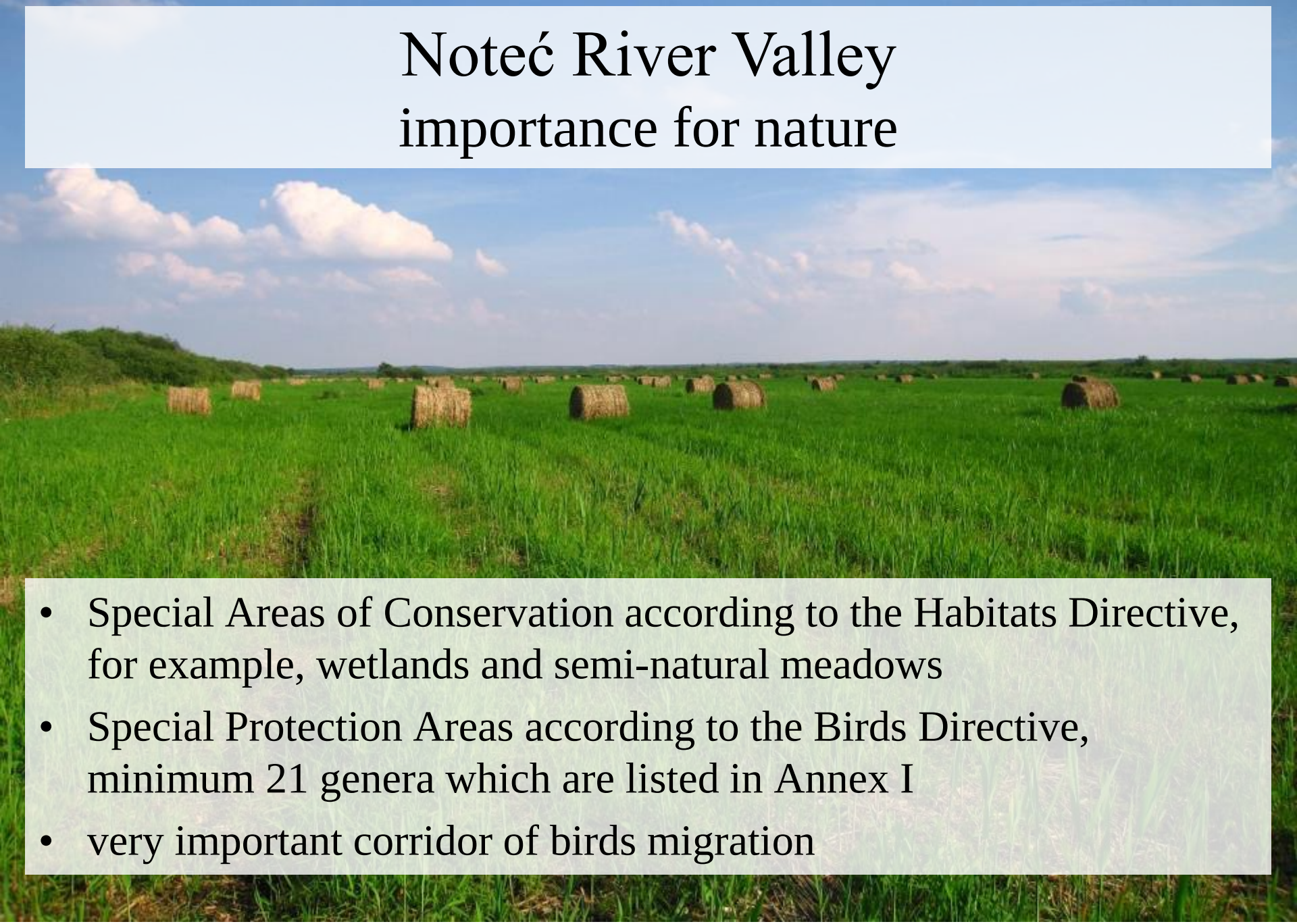


Noteć River Valley
Barycz River Valley
Przemkowski Landscape Park

Noteć River Valley
characteristics of natural properties

- about 180 km long, 2-13 km wide, 78,000 hectares
- the Valley landscape is dominated by extensively used meadows, which comprise approximately 85% of the area
- one of the most important ecological corridors (Oder - Vistula)
- included in Natura 2000

Noteć River Valley
importance for nature

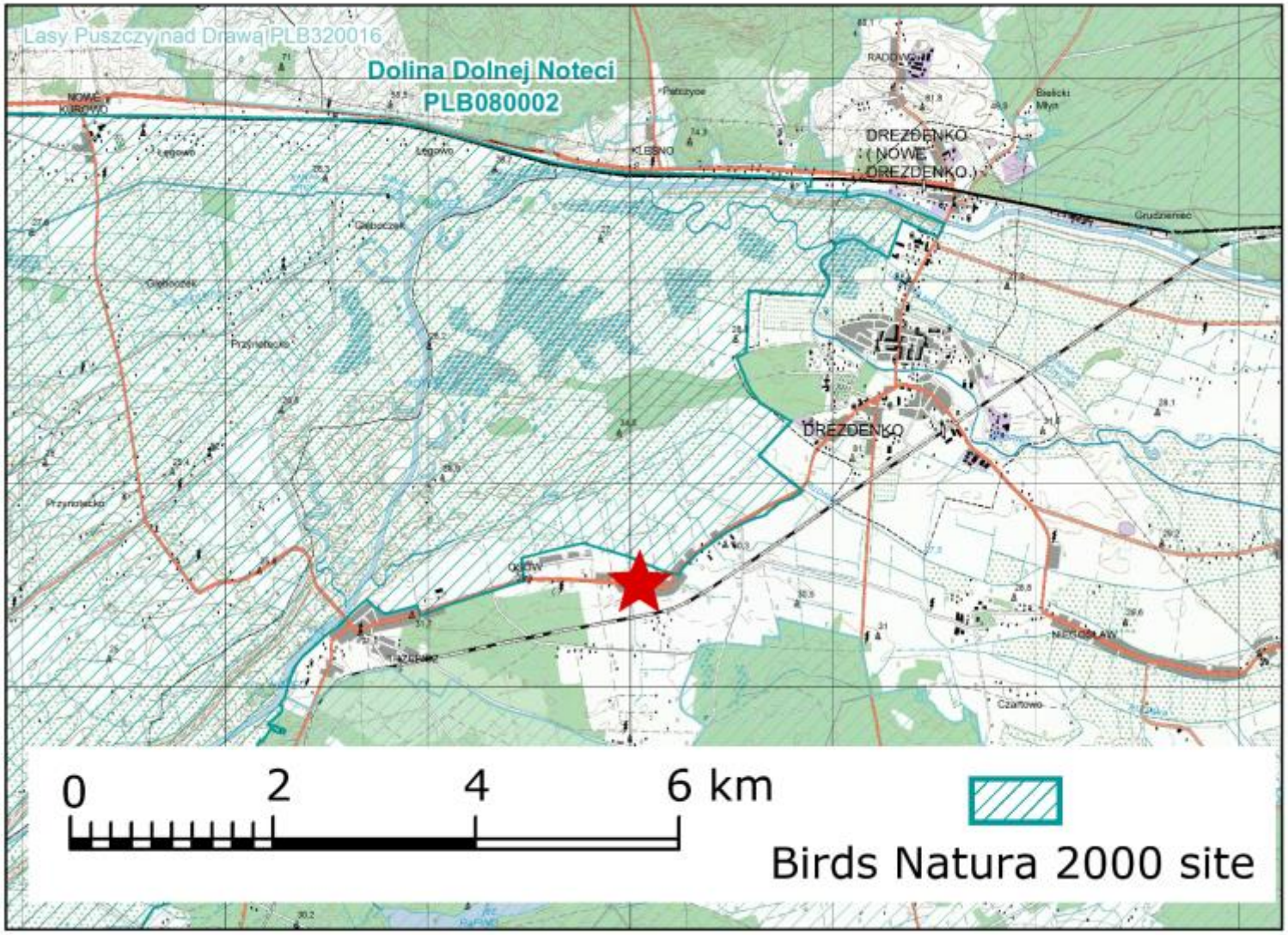


- Special Areas of Conservation according to the Habitats Directive, for example, wetlands and semi-natural meadows
- Special Protection Areas according to the Birds Directive, minimum 21 genera which are listed in Annex I
- very important corridor of birds migration

Noteć River Valley
type of vegetation – raw material base

- syntaxons typical for riparian areas in Poland
- *Molinio-Arrhenatheretea* community with a rich flora characteristic of *Agropyro-Rumicion crispi* and *Calthion* alliances, differentiated towards *Phalaridetum arundinaceae*
- if abandoned, the communities evolve towards shrubby vegetation (e.g. *Alnion glutinosae*) and then to the woody vegetation (e.g. *Salicetum pentandro-cinerea*)

Polish case study – Site of IFBB implementation



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Biomass potential of the Noteć River Valley based on semi-natural grassland

On the basis of the information obtained from the local farmers and also acc. to data estimated for statistical purposes, the biomass DM yield was assumed at the level:

$$5.0 \text{ t ha}^{-1}$$

The average biomass DM yield determined on the case study experimental plots in 2013:

$$10.98 \pm 2.83 \text{ t ha}^{-1}$$

Biomass collecting on the site

Application of conventional agricultural technics for meadow mowing and silage production (equipment adjusted to wet areas, delayed cutting date – higher DM content in biomass, microbial inoculants necessary)

Content of constituents in silage and press cake

Elements	Silage		Press cake	Difference (%)
Dry matter (DM)	39.5	Hydrothermal conditioning	31.7	- 20
Ash (g kg^{-1} DM)	72.0		35.0	- 51
N (g kg^{-1} DM)	12.3		7.0	- 43
Cl (g kg^{-1} DM)	6.1		0.8	- 87
S (g kg^{-1} DM)	2.8		0.9	- 68
K (g kg^{-1} DM)	8.2		1.1	- 87
Ca (g kg^{-1} DM)	11.7		4.1	- 65
Mg (g kg^{-1} DM)	2.4		0.5	- 79
P (g kg^{-1} DM)	1.8		0.4	- 78

Source: Danubenergy final report, 2015

Test combustion characteristics of IFBB briquettes from Polish case study site

Dominant species	*Phalaris arundinacea, Carex acutiformis, Carex acuta*	
Dry matter (DM)	% DM	93.3
Heating value (LHV)	(MJ kg^{-1} DM)	17.94
	(MJ kg^{-1} FM)	16.57
NO_x (limit value 500)	mg m^{-3} (reference 11% O_2)	349.5
CO (limit value 250)		94.5
SO_2		70.8
Particulate matter (limit value 50)		30.3

Source: Danubenergy final report, 2015

Planned investment

- Plant investor – BioEn Ventures
- IFBB add-on installation
- Substrate for biogas plant – vegetable waste and chicken manure
- Raw material base – grassland area covered with the agri-environment scheme „Birds protection”
- Substrate for IFBB add-on – biomass collected from 1st August in form of silage
- 1,000 ha of extensive flooded grasslands located up to 15 km from the plant
- 1 cut per year, 5 tones DM per ha

Economic analysis

Pre-calculation of an IFBB plant in Poland

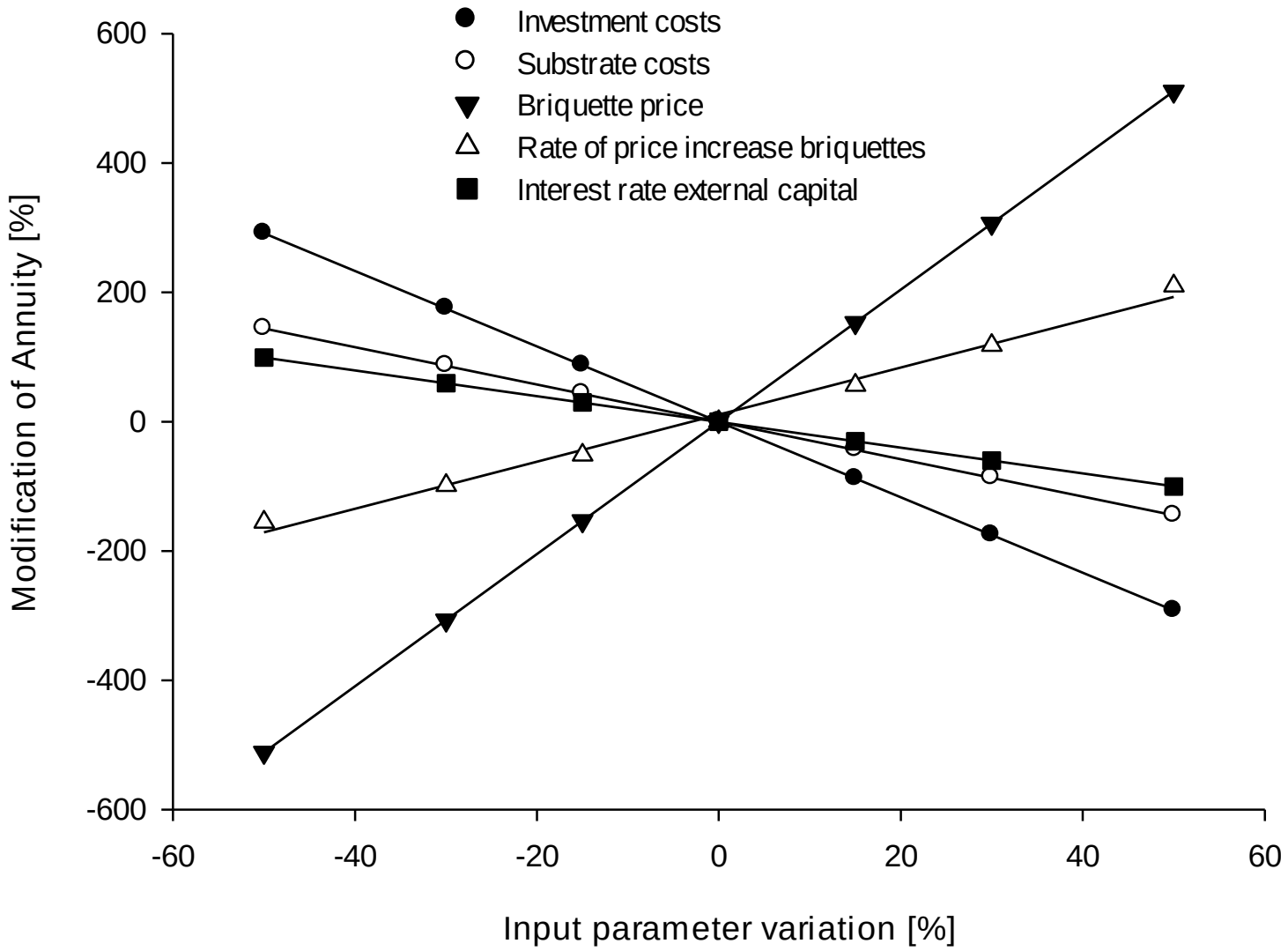
Assumptions:

Parameter	**Unit**	**Value**
Biomass throughput	t DM / year	5,000.00
Grassland production costs	€ / t DM	35.00
Electricity costs	€ ct./kWh$_{el}$	10.70
Heat costs	€ ct./kWh$_{th}$	3.00
Briquette price	€ / t	100.00
Rate of briquette price increase	% / year	5.70
Briquette production	t DM / year	4,686.00
Electricity production	kWh$_{el}$ / year	1.35mn

Economic analysis

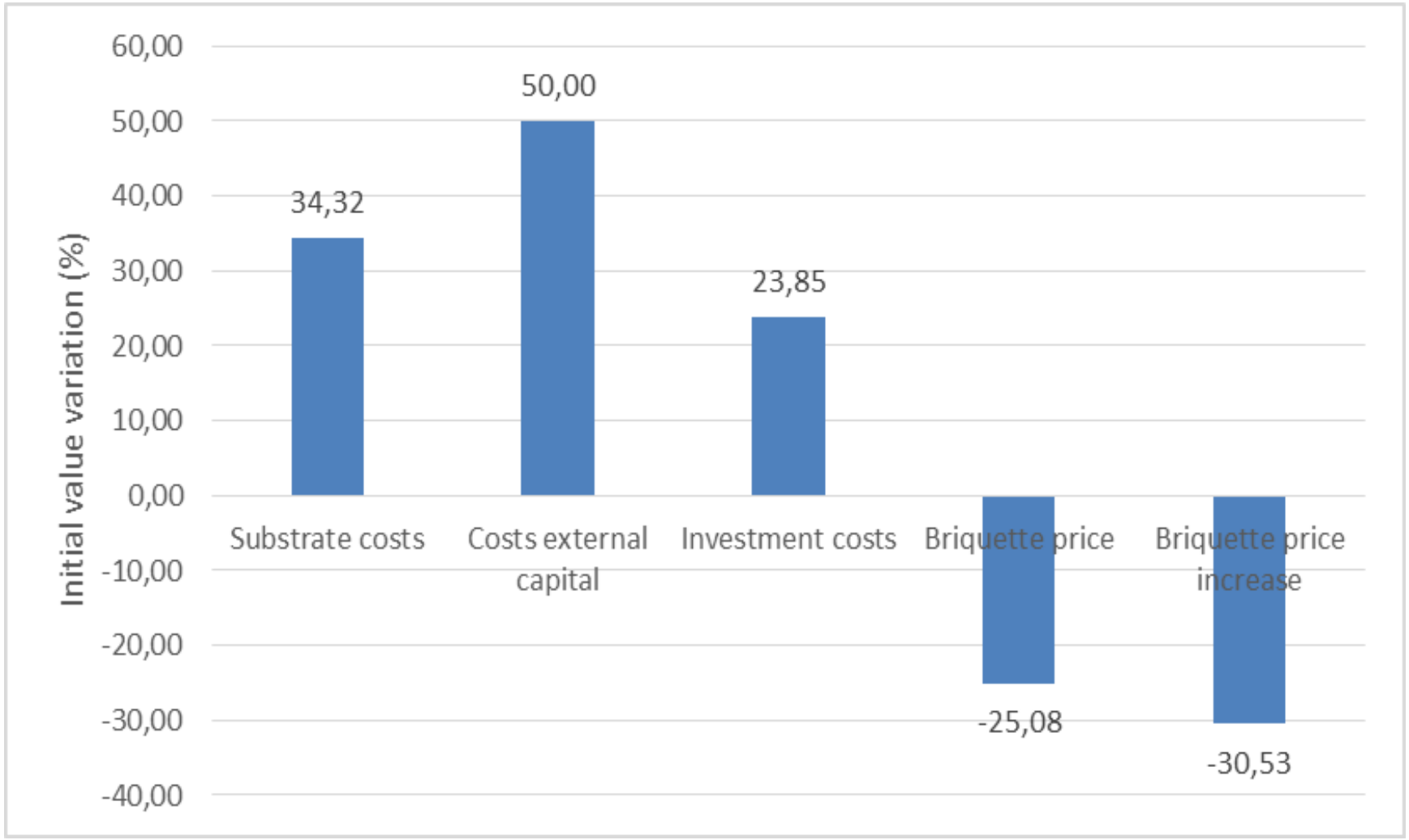
Total investment costs (€)		2,235,493
Capital-related costs total (€ a^{-1})		343,139
Operation-related costs total (€ a^{-1})		70,606
Consumption-related costs (€ a^{-1})		
	Electrical process energy	206,655
	Thermal process energy	148,268
	Substrate input	199,054
	Total	553,977
Other costs (€ a^{-1})		
	Total	14,989
Total costs (€ a^{-1})		**982,711**
Incoming payments (€ a^{-1})		
	Electricity (market sales)	-
	Electricity (from green certificates)	348,210
	Electricity (heat usage)	-
	Grasbriketts	703,315
Total incoming payments (€ a^{-1})		**1,051,525**
Total annuity (€ a^{-1})		**68,814**
Internal Rate of Return (%)		**11.05**

Economic sensitive analysis



Source: Danubenergy final report, 2015

Critical values of the parameters change in the calculation of return on investment



Source: Danubenergy final report, 2015

Conclusions

- riparian vegetation in Poland is dominated by plant communities which provide promising substrate for the bioenergy production using IFBB technology
- schemes created for protection of birds and Natura 2000 habitats on semi-natural grasslands in Poland favors the application of IFBB technology
- based on experiences from the Noteć River Valley in Poland as part of Danubenergy project, the use of IFBB enables efficient bioenergy production and has an economic potential

Thank you for your attention!