CALCULATION OF SHORT-TERM GREENHOUSE GAS EMISSIONS BY USING FUZZY NEURAL NETWORK

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- **Economical development and Energy system of Ukraine**
- **Renewable energy sources and Green Tariffs**
- **CO_2 emissions: status and trend**
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Geo-situation of Ukraine, base Statistic Indicators

	IEA (2007)	IEA(2008)*
Territory (thsd km2)	603.50	603.5
Population (mln)	46.79	46.26
	45,415,596 (July 2010 est.)	
GDP (billion 2000 US$)	48.44	53,47
GDP (PPP) (billion 2000 US$)	307.61	339,52
TPES (Mtoe)	137.43	136,14
TPES/Population (toe/capita)	2.94	2,94
TPES/GDP (toe/thousand - 2000US$)	2.84	2,55
TPES/GDP (PPP) (toe/thousand)	0.45	0,4
Electricity Consumption (TWh)	159.06	163.49
Electricity Consumption/ Population (kWh/capita)	3400	3534
Energy Production (Mtoe)	82.77	81,29
Net Imports (Mtoe)	56.2	59,36
CO2 Emissions (Mt of CO2)	310.29	309.58
CO2/TPES (t CO2/toe)	2.26	2,27
CO2/Population (t CO2/capita)	6.63	6.69
CO2/GDP (kg CO2/2000 US$)	6.41	5,79
CO2/GDP (PPP) (kg CO2/2000$ PPP)	1.01	0,91

* - Sources: Key world Energy Statistic, IEA, 2010

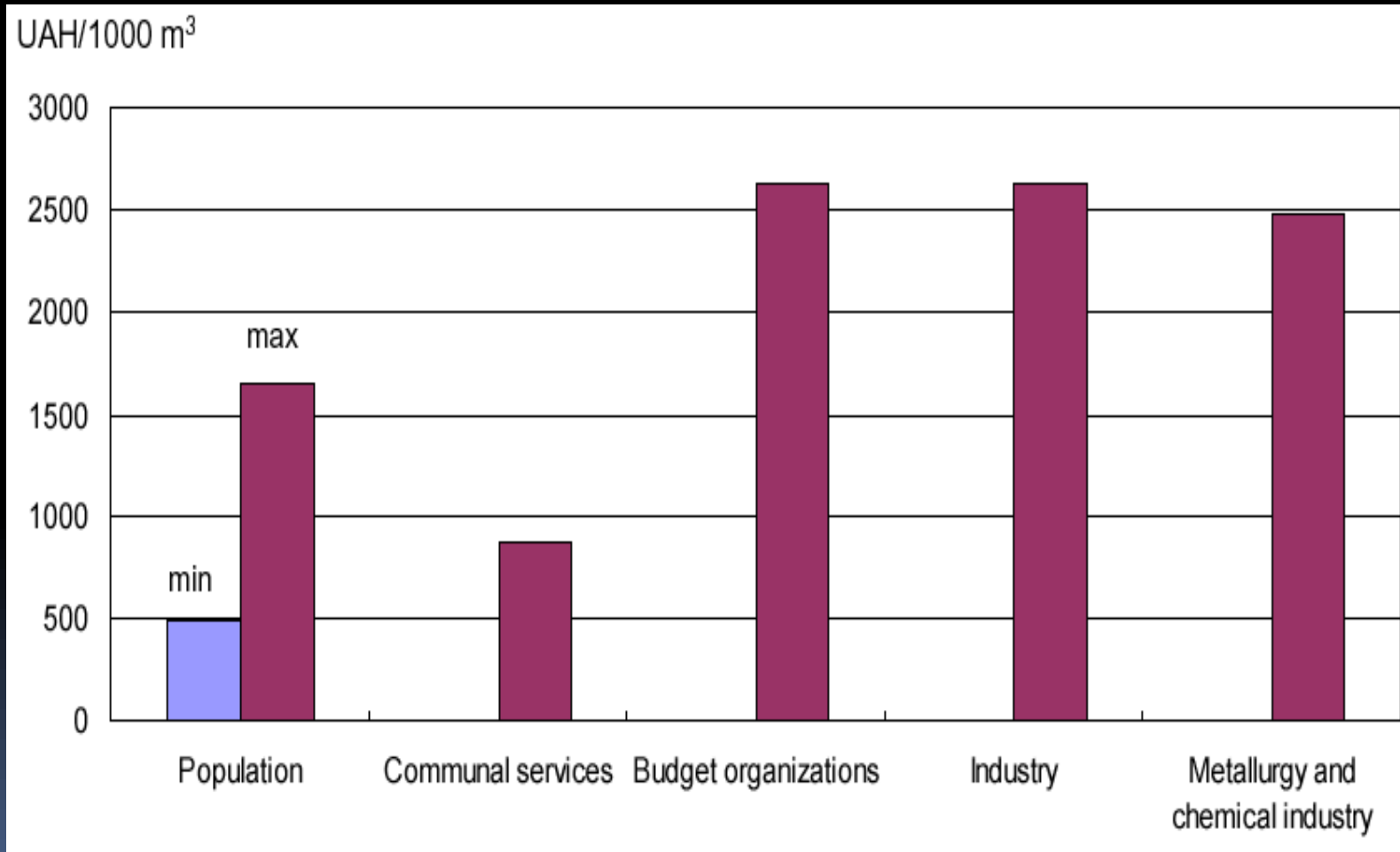# Dynamic of economical development in Ukraine in period 1990-2010
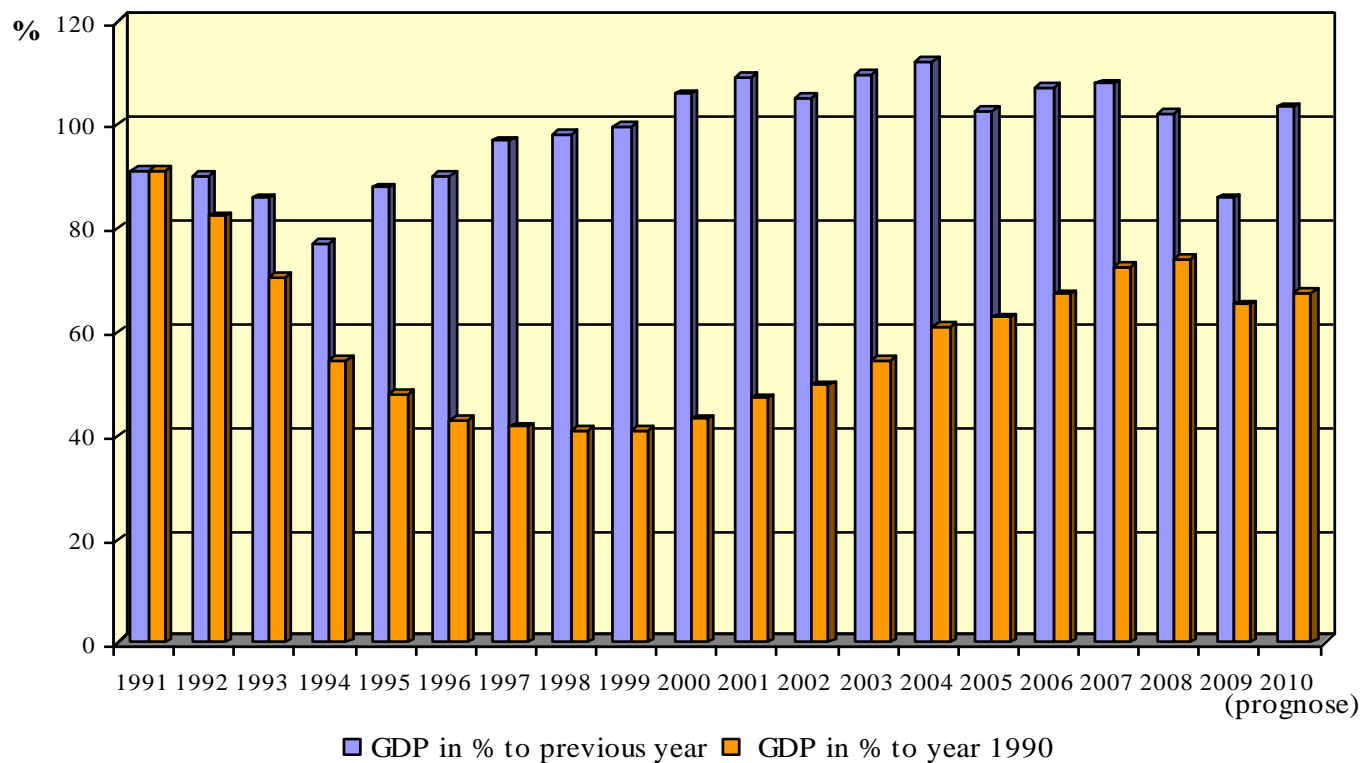
Energy Intensity by Country
(2007 PPP; toe/thousand 2000 USD)

Energy indicator for selected countries (ppp)
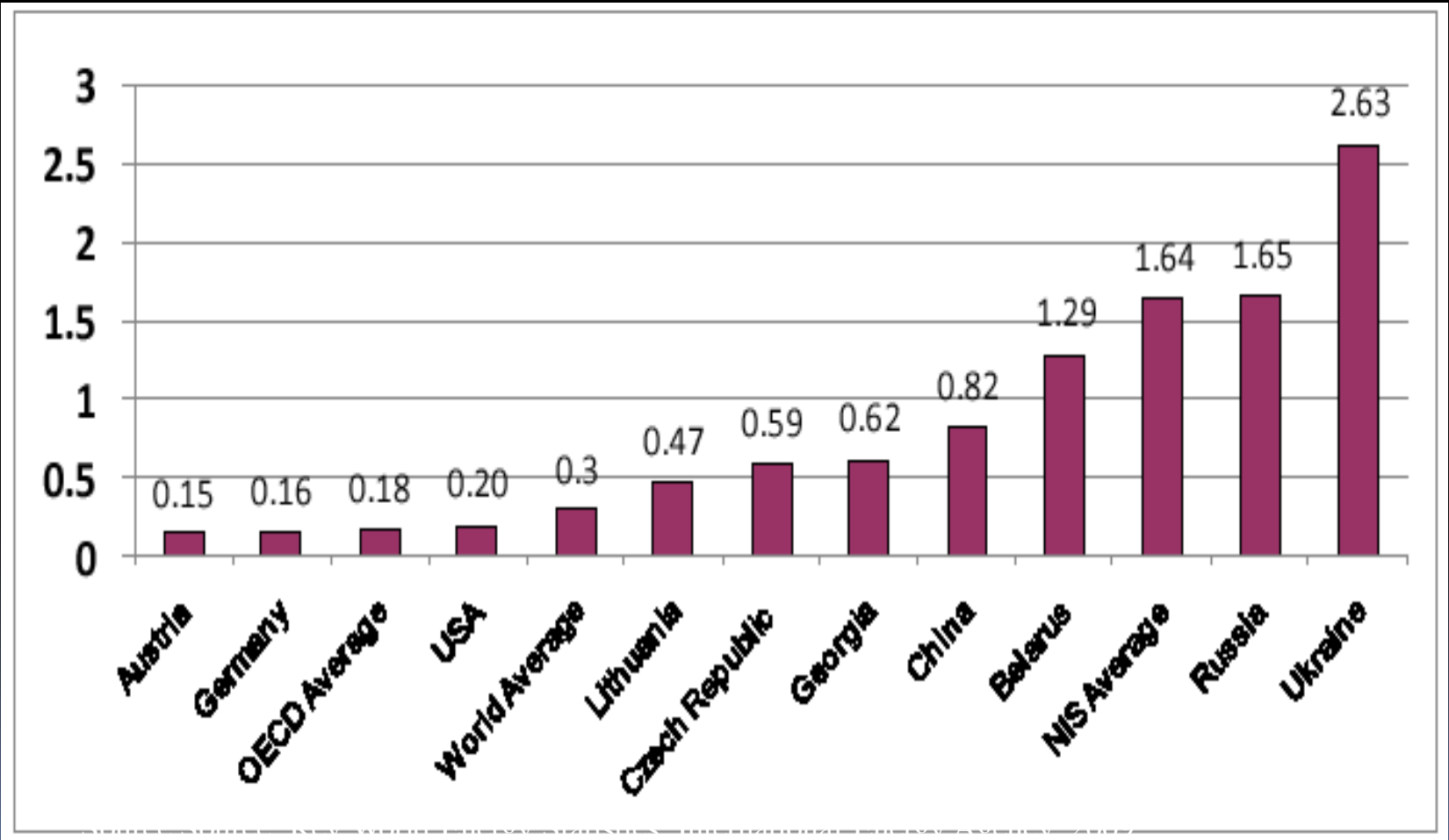
Internal prices of natural gas in Ukraine for different types of consumers

Law on "Green tariffs"

adopted by Parliament in March 2009 and enforcement mechanisms for this Law was developed and adopted by NERC only on July 2009

Stimulated rate for energy producer for sale the energy to Energy Market:

- for energy from biomass -2,3;

- for energy from wind – 1,4;

- for energy from solar (PV) – 4,4;

- for small hydro plants – 0,8.

Green tariffs in Ukraine

| ELECTRICITY PRODUCED WITH:		Formula	Retail price for electricity for 2nd class consumers as for January 2009, EUR/KW	"Green" tariff level factor	Peak time factor	TARIFF EUR/KW
			A	B	C	
Wind energy	By objects with rated capacity up to 600 KW	A*B	0,05385	1,2	not applied	0,0646
	By objects with rated capacity over 600 KW but not exceeding 2000 KW	A*B	0,05385	1,4	not applied	0,0754
	By objects with rated capacity over 2000 KW	A*B	0,05385	2,1	not applied	0,1131
Biomass energy		A*B	0,05385	2,3	not applied	0,1239
Solar energy	Surface power facilities	A*B*C	0,05385	4,8	1,8	0,4653
	Power facilities fixed (installed) on roofs of houses, buildings and constructions with rated capacity over 100 KW	A*B*C	0,05385	4,6	1,8	0,4459
	Power facilities fixed (installed) on roofs of houses, buildings and constructions with rated capacity not exceeding 100 KW as well as for objects fixed (installed) on the facades of houses, buildings and constructions with rated capacity regardless their rated capacity	A*B*C	0,05385	4,4	1,8	0,4265
Small hydro power plants		A*B*C	0,0538	0,8	1,8	0,0775

Greenhouse gas inventory information for the period 1990-2006, mln tCO$_2$-e, % to 1990 level
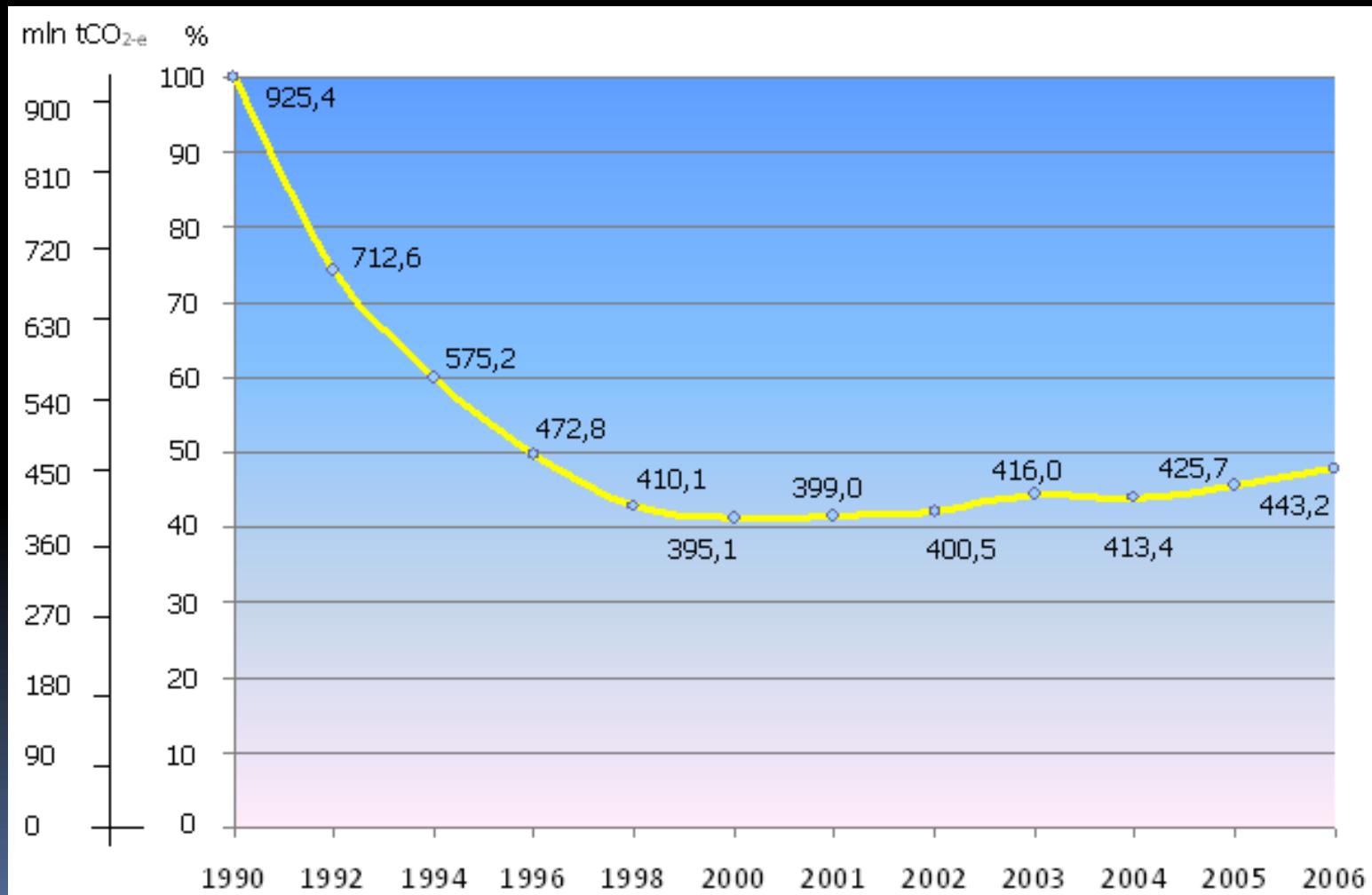
Forecast for CO_2 emission,
% to 1990 level
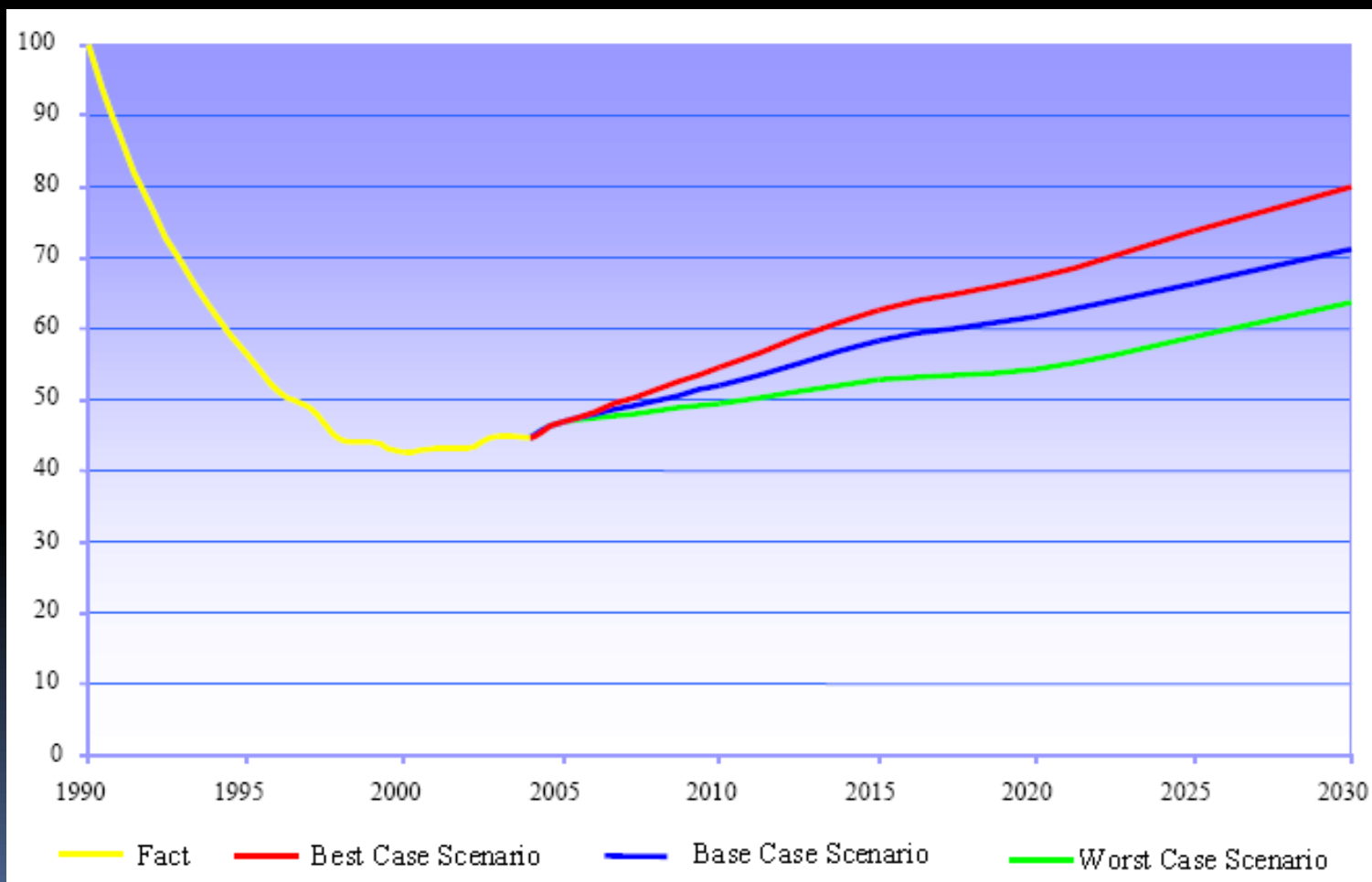
Forecast of CO_2 emission structure,
mln.t of CO_2 - equivalent
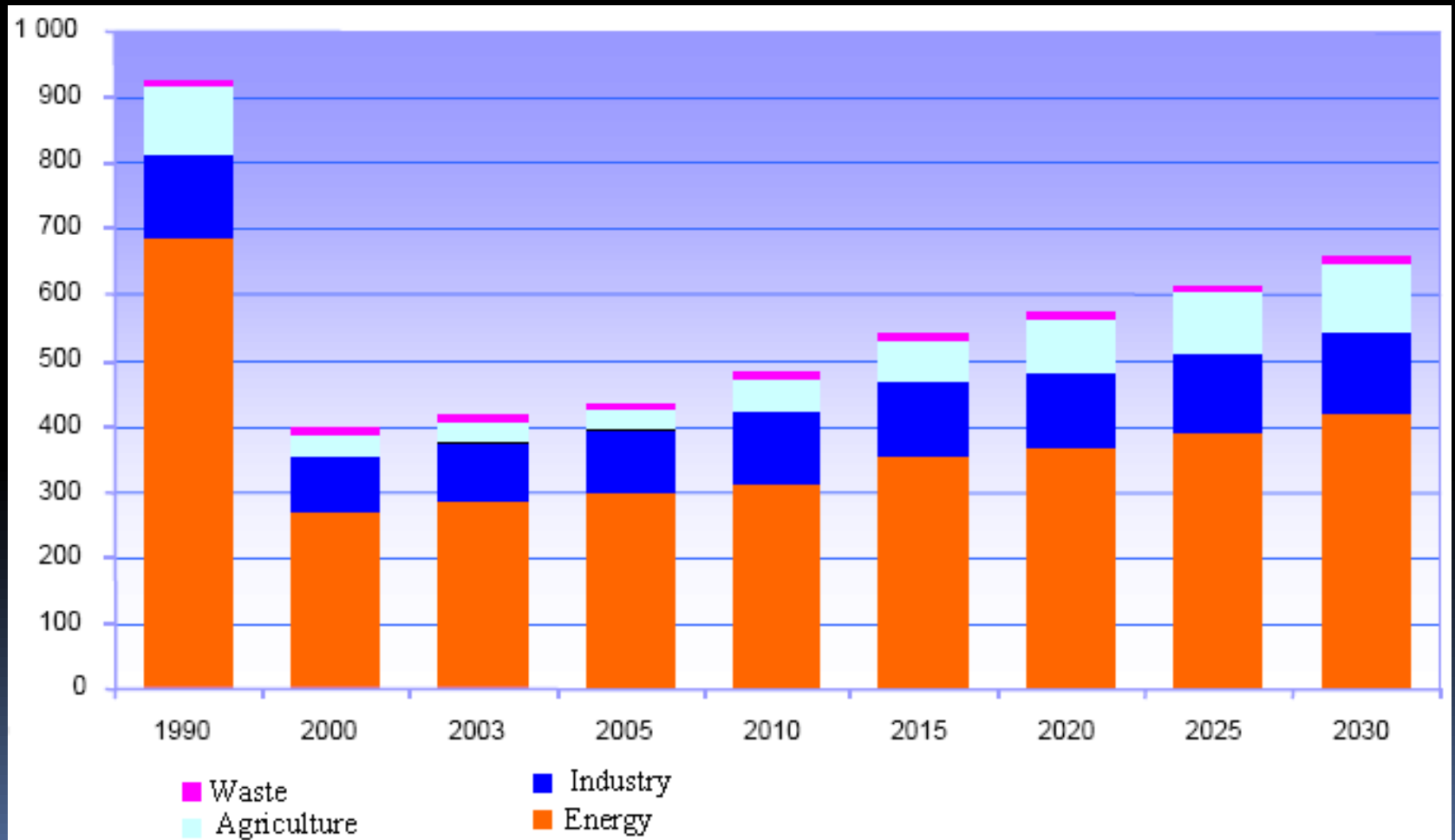
Background for shot-term forecast of GHG emissions

- Ukraine has the opportunity to use the GHG reductions not only to improve the environmental situation, but also to strengthen its economic and political conditions.

- One way is to trade emissions of GHG on the carbon stock, other – JI projects.

- Short-term and operational forecast of GHG is an integral part of planning, management and trade on the carbon stock.

- We suggested fuzzy neural network as a method of forecasting.

Emissions Trading Scheme takes into account only emissions of CO_2 from large sources of heat power industry, as well as selected energy-intensive industrial sectors:

- Refineries,
- Coke ovens,
- Steel mills,
- Incineration plants,
- as well as enterprises producing cement, glass, ceramics, pulp and paper...

It is planning the opportunity to enter the stock market not only at national level but also at the level of large enterprises, such as metallurgy, oil refining and cement in Ukraine.

Existing carbon exchange trading financial instruments (futures, options and spot contracts) on the basis of European emission permits:

- European Climate Exchange (ECX - 88% of total turnover),

- Austrian Energy Exchange – Powernext,

- European Energy Exchange (EEX) - Nord Pool

For short-term forecast of GHG was designed the Mamdani-type FNN, which was developed by Fuzzy Logic Toolbox Matlab software version 7.0.

GHG emissions

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temperature
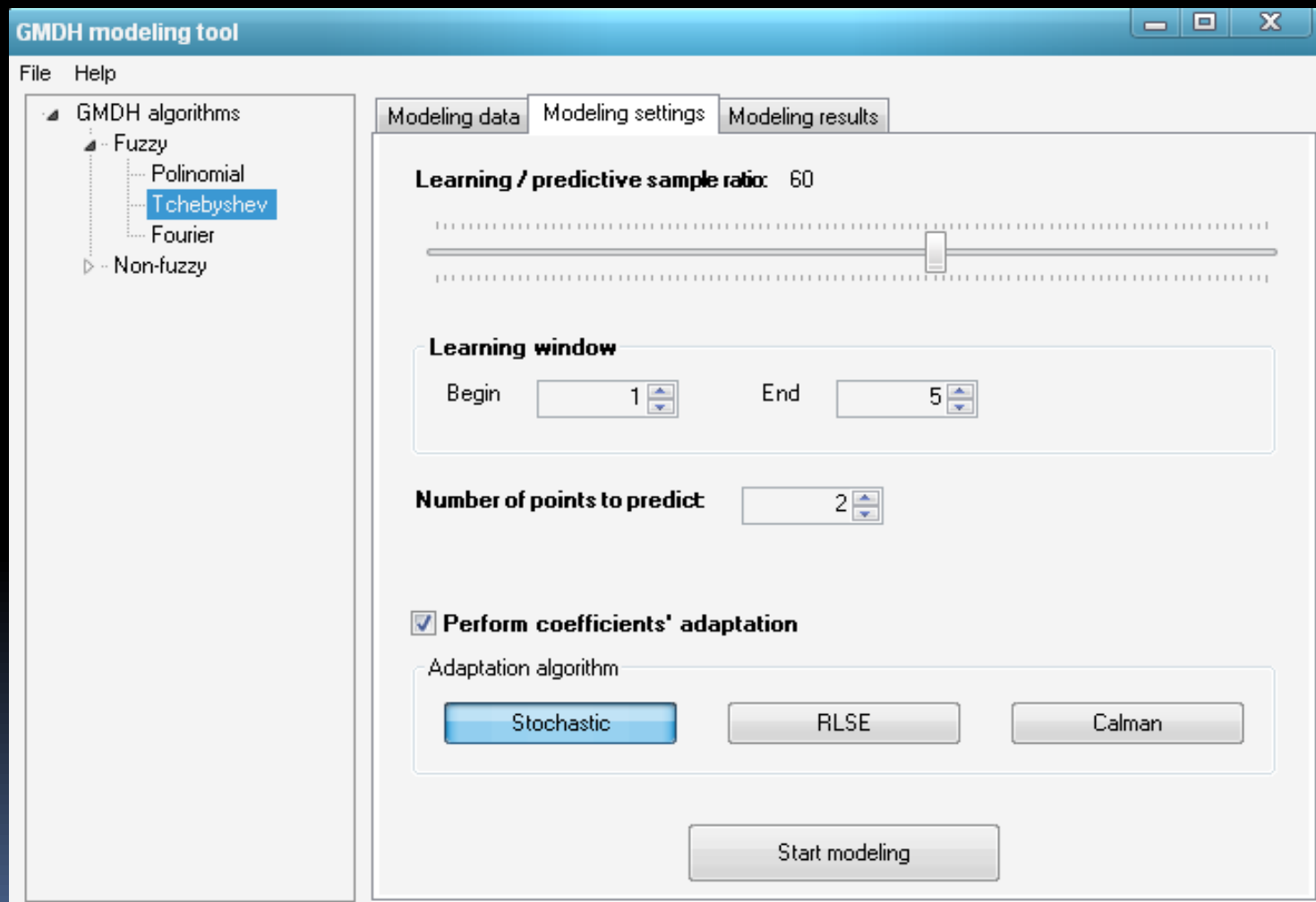
Mamdani-type FNN

Base of rules

GHG emission forecast
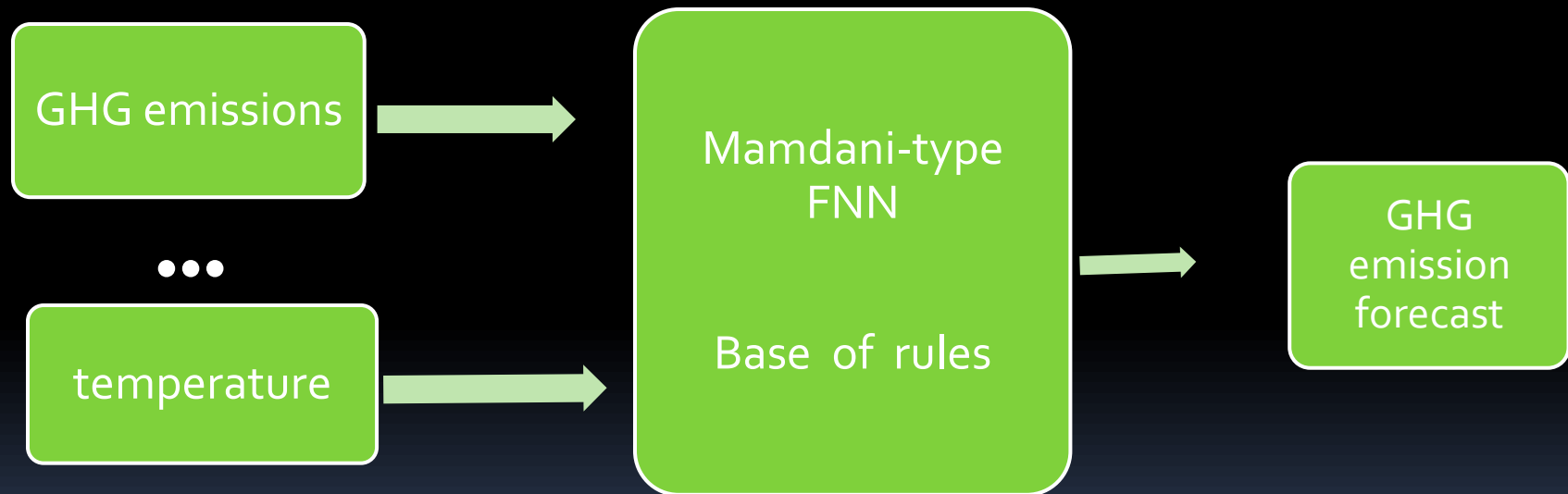
The dependence represents a surface where the abscissa is given the current value of CO2 emissions, and the ordinate ask the air temperature, and on the z-axis - the value of the forecast CO_2 emissions.
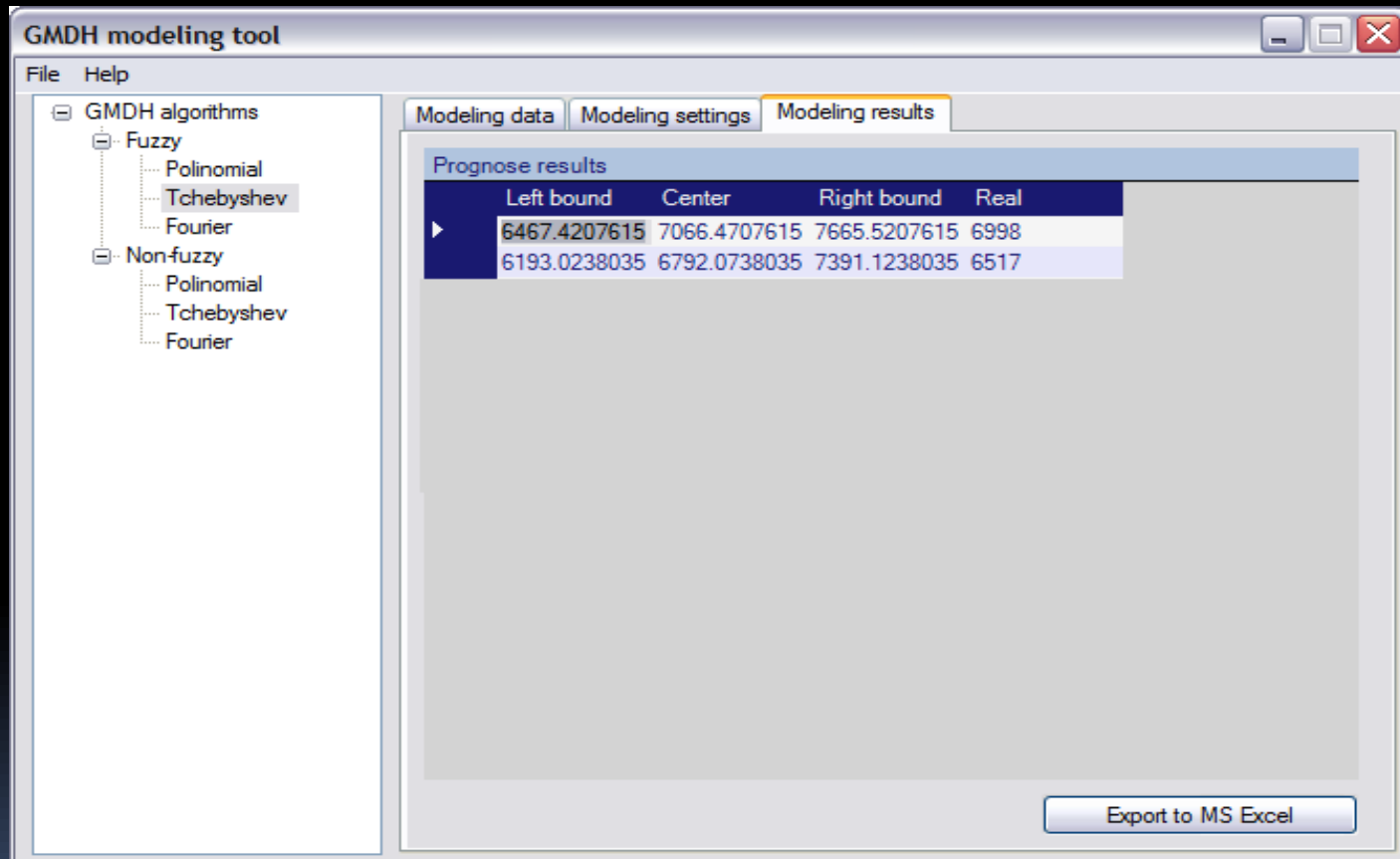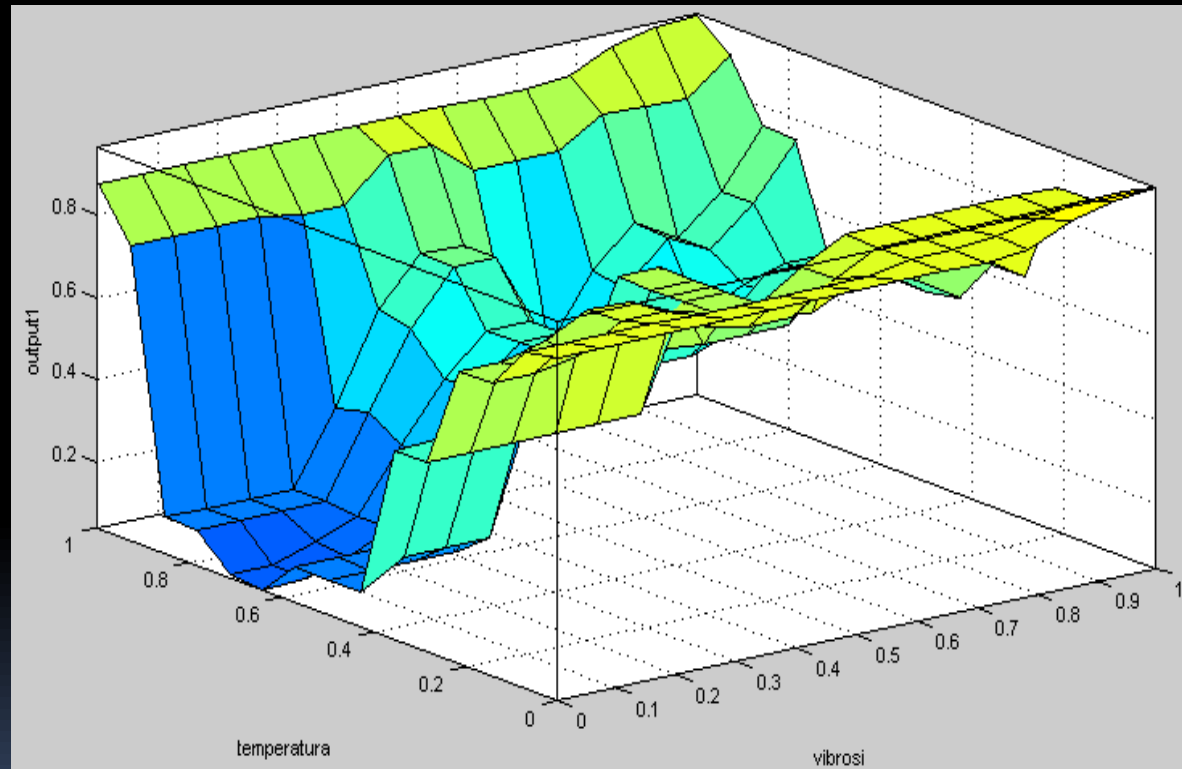

The results was more than 20% from real

We used also another method and software developed at NTUU "KPI", Institute of Applied System Analysis. The program named GMDH

After the procedure opens the tab «Modeling results»

This result differs from the actual by 10%

Conclusion

- Ukraine has a huge potential for using flexible mechanisms of Kyoto Protocol and hopefully also for post – Kyoto Agreements.

- Ukraine plane to enter the stock market not only at national level but also at the level of large enterprises, such as metallurgy, oil refining and cement.

- Fuzzy systems are universal approximaters and can produce accurate forecasts, but their design and configuration requires validated data bases.

Thank you for your attention

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