Estimation of Carbon Dioxide formation in heat-power complexes of the Central Asia and perspective of development of Hydrogen power engineering

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Total stocks of mineral fuel of the Central Asian Region (Mln t):

natural gas - 3419.5

oil - 1156.4

- coal - 3873.4

Emission of pollutants in Central Asia Region

SO_2 - 31%

CO_2 - 14 %

nitric oxides - 10 %

suspended particles - 35%

Power supply systems of the Republic of Uzbekistan

UZBEKENERGO

largest manufacturer electric and thermal energy

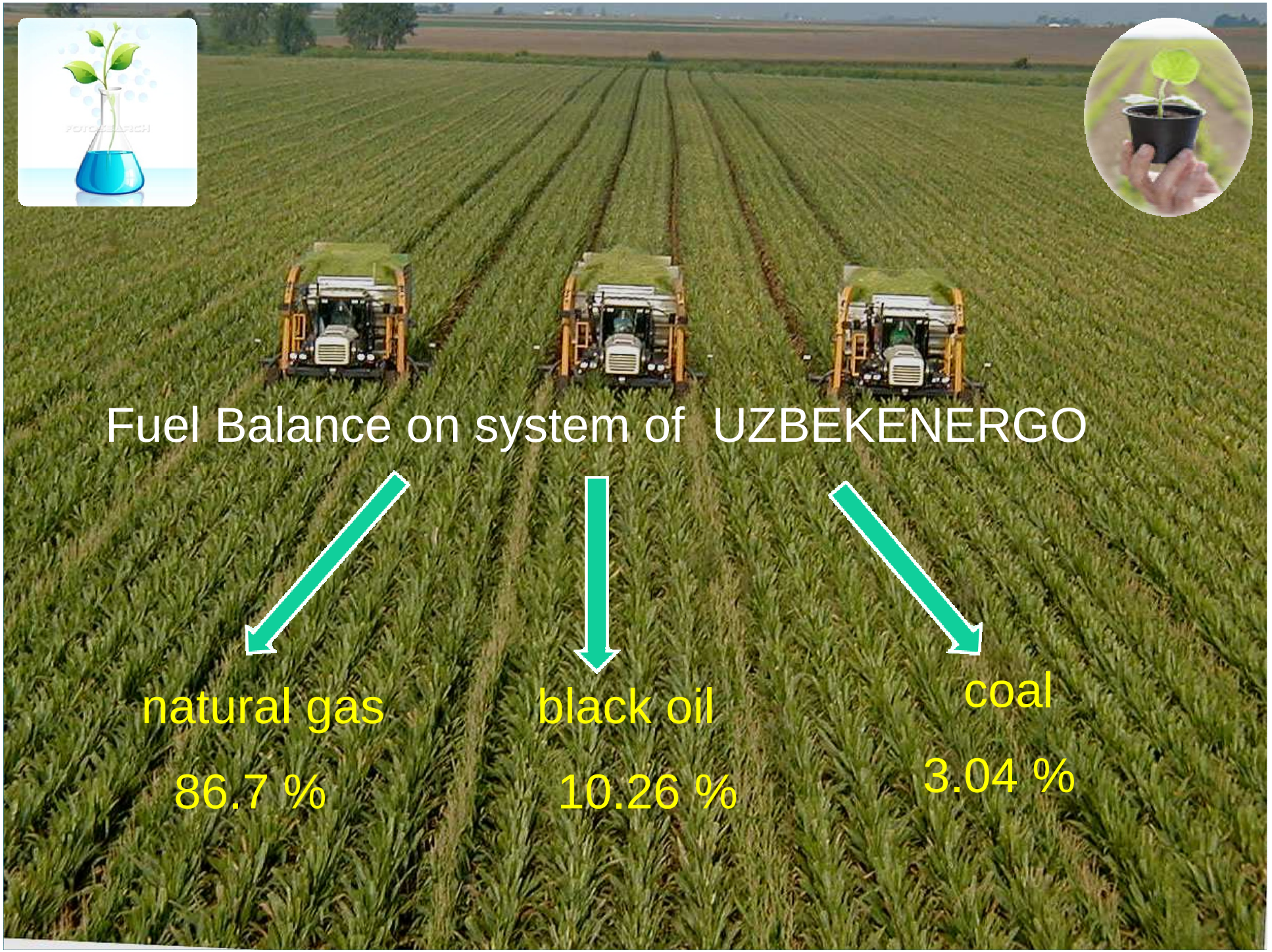
11238 MWt

covers of requirements in

electric - 98 %

thermal energy - 35 %

at burning in coppers of stations of natural gas, black oil, coal and gas of underground gasification of brown coal


Fuel Balance on system of UZBEKENERGO
natural gas
86.7 %
black oil
10.26 %
coal
3.04 %

Basic emissions of toxic components in atmosphere

206,143 Th. t

coal ashes	– 47.94 Th. t
sulfur dioxide	– 120.12 Th. t
nitrogen oxides	– 37.166 Th. t

In 2004 emissions of a dioxide of carbon have made

29640 Th. t

and have increased in comparison of 2002 by

240 Th. t

Power supply systems of the Republic of Kazakhstan

- Requirements of Kazakhstan on heat and energy development are satisfied on 85% by burning of coal. Average efficiency of power stations in Kazakhstan, burning coal, makes **30-32 %** whereas, according to a technical substantiation, this indicator makes **42 - 53 %.**

- The potential of reduction of emissions CO_2 in the project on transition to other kind of fuel makes about **40 %,**without increase in efficiency of use of superfluous energy in these projects.

- Concerning coal potential in power sector of Kazakhstan, transition to other kind of fuel can provide reduction to an indicator of **37 Mln. t CO_2** equivalents per year.
- 12 % of the electric powers of Kazakhstan are developed from renewed energy sources, mainly from five large HPS. In the National Report is note that from 90 small HPS in Kazakhstan 21 is in operation. The general power output of all workstations makes 78 MWt. Except possible restoration of old hydroelectric power stations, Kazakhstan creates large Hydropower system by capacity of **450 MWt**.

Power supply systems of the Republic of Kirgizstan

In 2004 emissions of CO_2 gas in the Kirgizstan were considerable more **12 Mln. t.** The largest source of emissions of carbonic gas is the power sector, also cargo and passenger motor transport

According to UN Program for economic of Central Asia and diagnostic report «Rational and the effective utilization of power resources in the Kirghiz Republic» up to **2020** is predicted manufacture growth of electro- and heat energy on thermal power station and on the basis of use of coals of the Kara-keche cut is supposed to consider possibility of building of the Kara-keche thermal power station by capacity **800 MWt** that will obviously promote increase in emissions of greenhouse gases in atmosphere

Power supply systems of the Republic of Tajikistan

Stocks of coal	670 Mln. t (40 fields)
Production	20-25 Th. t
Stocks of oil	5.4 Mln. t
Stocks of natural gas	9.2 Bln. m^3

Strategy of social and economic development of Tajikistan provides increase to 2015

coal mining	600-800 Th. t
Oil production	100-300 Th. t
Production of natural gas	300-500 Mln.m^3

Taking into account growing needs for energy, at a share of coal fuel more than 50% in the general power consumption, emission of CO_2 by 2015 can increase to 30 Mln. t.

Total Hydropower Resources of the Central Asia Region

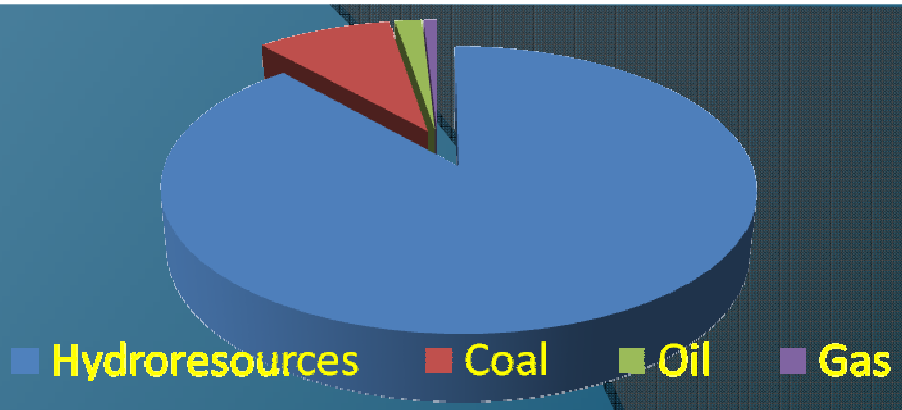
460 Bln. kWt·h/year

*At present used only **10 %***

The main volume of a regional stock of hydroenergy

Tajikistan - 69%

Kirgizstan - 22%



Summer operating mode of the
Nurek reservoir (July - September)

Single dumping - 600 m^3/sec.
Water volume - 4.5 $км^3$

2012

Single dumping on an equivalent
to electricity - 6 Bln. kWt·h
Losses (1кВт.ч = 3 cents) - $200 Mln.

Territorial Location of Hydropower Stations

Criterion of economical optimization of territorial arrangement of HPS :

minimization

investment for the building of HPS

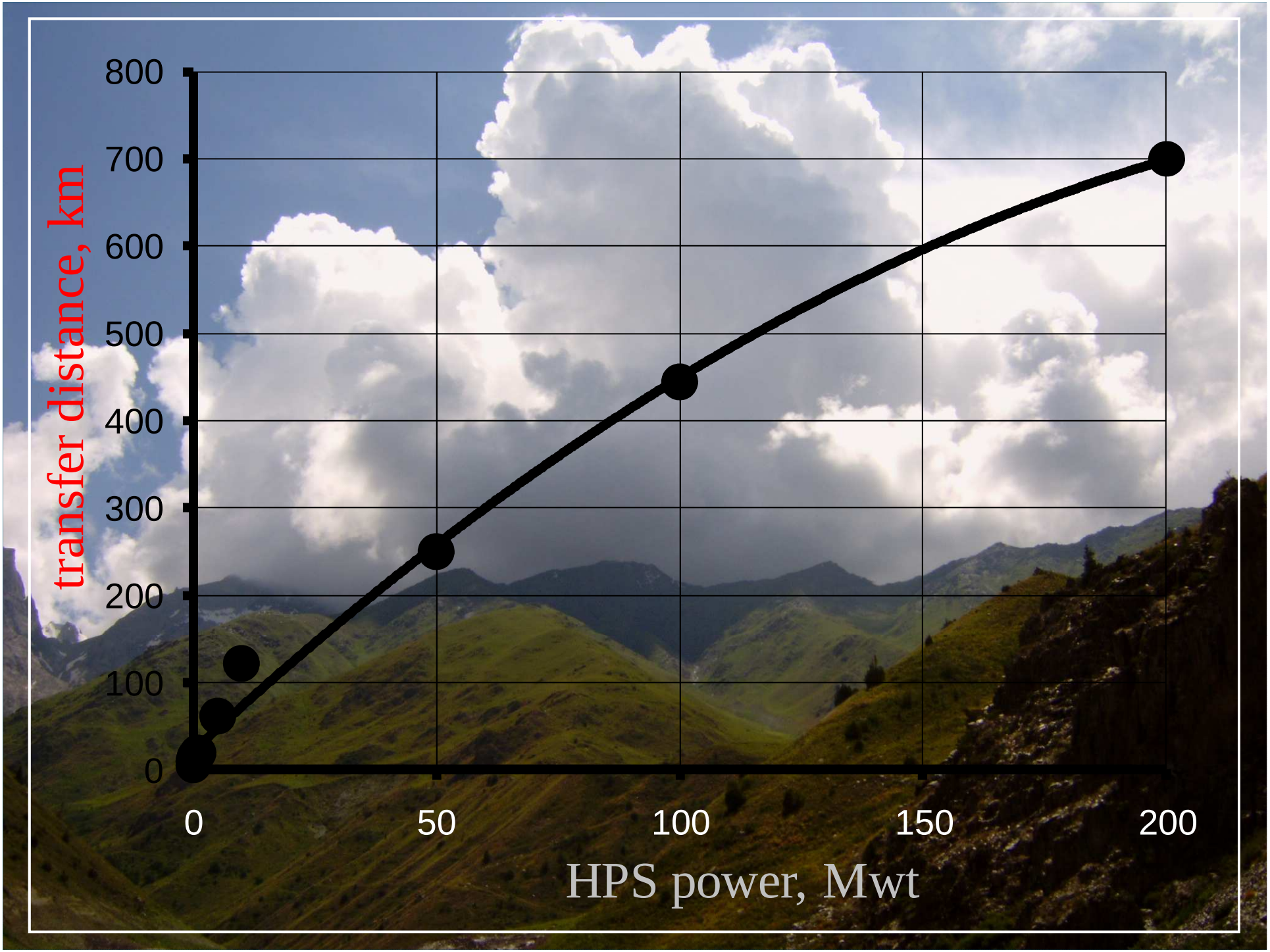
+

investment for construction of ETL (Electricity transfer lines) for the transit of power to consumers

If the zone of influence of one HPS will be limited by distance throughout which cost of power transfer by construction of the ETL will be cheaper than a construction of new HPS on the end of the ETL

Mathematically it can be written as:

$$L_{\max}^{\text{opt}} \leq \frac{S_{\text{spec}}^{\text{HPS}}}{S_{\text{spec}}^{\text{ETL}}} N$$


800
700
600
500
400
300
200
100
0
transfer distance, km
0
50
100
150
200
HPS power, Mwt

Ecology-economical Index efficiency of HPS	On capacity references to the area for building HPS **(MWt / ha)**	On power output references to the area for building HPS, **(TWt / ha)**
Annual for HPS with area of ground less 100 th. ha	**0. 123**	**0.406**

Estimation efficiency now current Nurek HPS and planed in the near future for building of Rogun HPS with reservoirs

Ecology-economical Index efficiency of HPS	On capacity references to the area for building of HPS (MWt / ha)	On power output references to the area for building of HPS, (TWt / ha)
Annual for HPS with area of ground less 100 th. ha	**0. 123**	**0.406**
Bratsk HPS	**0.008**	**0.041**
Charvak HPS	**0.130**	**0.436**
Toktogul HPS	**0.038**	**0.128**
Nurek HPS	**0.126**	**0.522**
Rogun HPS	**0.212**	**0.782**

THE ENVIRONMENTAL PROBLEMS AND ECOLOGICAL ASPECT OF HYDROGEN TECHNOLOGY

Work of any internal combustion engine depends on the engine type, kind of fuel, working condition mode and products of combustion, the following structure is formed (% vol.) :

CO : 1 – 9

CO_2: 2 – 10

H_2: 1 – 7

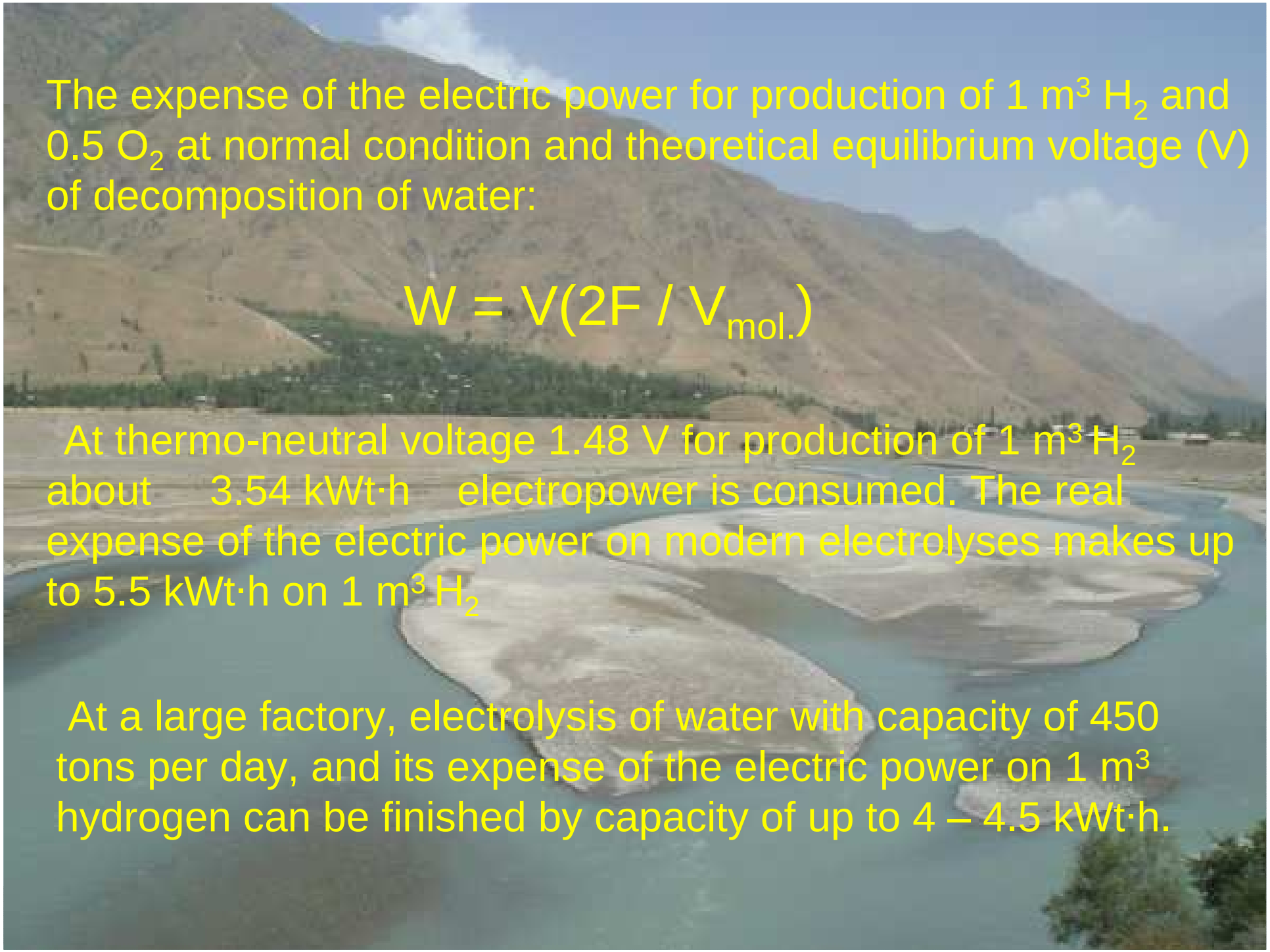
O_2: 0.5 – 5

N_2: 69 – 79

Use of hydrogen as an energy carrier allows considering and solving power problems, those related with ecological problems as well

PRODUCTION OF HYDROGEN BY ELECTROLYSIS OF WATER

Electrolysis of water is one of the most known and well investigated methods for production of pure hydrogen **(99.6 – 99.9 % H_2)** in one technological stage. Efficiency of hydrogen production process by electrolysis is mainly defined by the electric power cost which makes up **to 85%.**



The expense of the electric power for production of 1 m^3 H_2 and 0.5 O_2 at normal condition and theoretical equilibrium voltage (V) of decomposition of water:

$$W = V(2F / V_{mol.})$$

At thermo-neutral voltage 1.48 V for production of 1 m^3 H_2 about 3.54 kWt·h electropower is consumed. The real expense of the electric power on modern electrolyses makes up to 5.5 kWt·h on 1 m^3 H_2

At a large factory, electrolysis of water with capacity of 450 tons per day, and its expense of the electric power on 1 m^3 hydrogen can be finished by capacity of up to 4 – 4.5 kWt·h.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REFERENCES

Normatov I.Sh. The water balance and the solution of water problems in Central Asian Region. ***IAHS Red Book Publ. №286. 2004. PP. 300-314.***

Normatov I.Sh. Regional experiences in solving of water resources problems in Tajikistan. ***Book: Building a New Asia. Ed: M. Singh. Kolkata, "SHIPRA". 2005, pp. 295-304.***

Normatov I.Sh. Creation of adaptation mechanisms the key to more cost-effective and environment-friendly water management. ***IAHS Red Book Publ. №338. 2010. PP. 74- 76.***

Normatov I.Sh. Modern adaptation approach of water consuming branches to climate changes and degradation of glaciers. **J. Environment Sci., 2013, No 4, PP.174-183.**

Normatov I.Sh. Estimation of the Carbon Dioxide Formation in Heat-Power Complex of the Central Asia and Prospective of Development of Hydrogen Power Engineering. **J. Environmental Sci. & Engineering A, 2013, V.11, No 4. PP.231-239.**