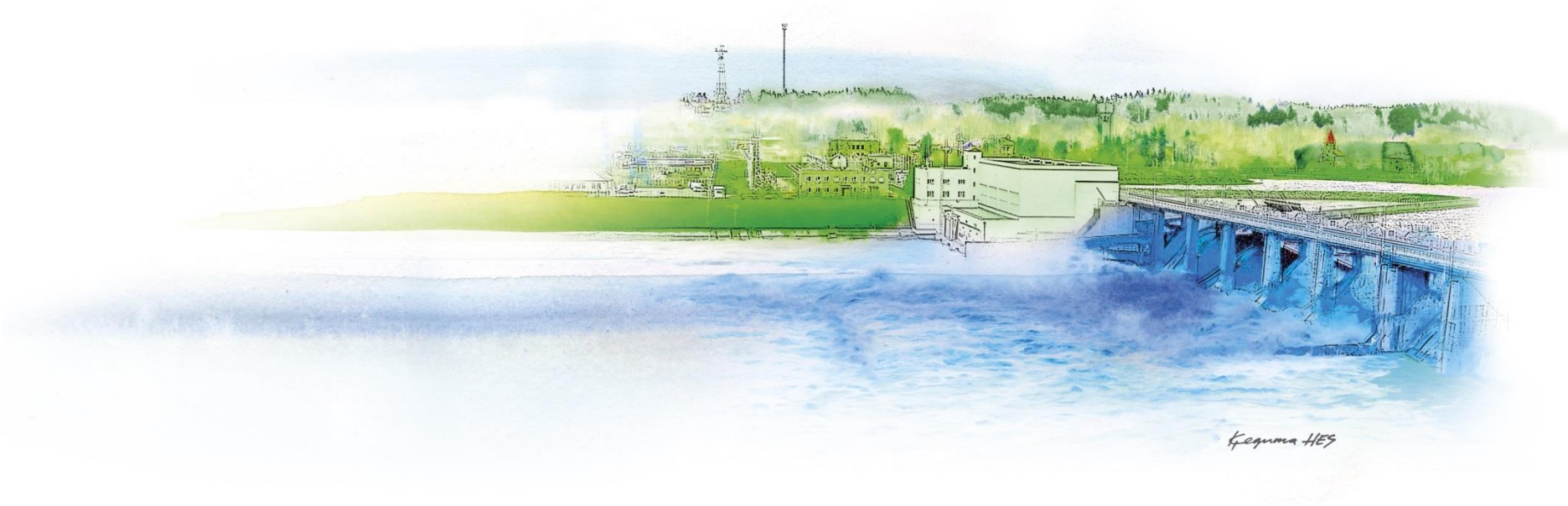
Flood risk management in power supply area



Andris Zēģele
AS «Latvenergo» HPP Technical director

Latvenergo

Group Profile

General

- Vertically integrated utility
- Wholly-owned by the Republic of Latvia
- 4,177 employees
- Latvenergo Credit rating: Moody`s – Baa2/stable

Latvenergo Group structure

Main facts

- Installed generation capacities:
  - 2,569 MW_{el}
  - 1,844 MW_{th}
- Length of power lines:
  - Distribution 94.1 thsd. km
  - Transmission 5.3 thsd. km
- Retail customers – 865 thousands
- Market share in the Baltics ~ 1/3

Operating segments

- Generation and supply (61% of revenues; 53% of EBITDA)
  - Latvenergo AS (LV)
  - Elektrum Eesti OU (EE)
  - Elektrum Lietuva UAB (LT)
  - Liepājas enerģija SIA (LV)
  - Enerģijas publiskais tirgotājs AS (LV)
- Distribution (29% of revenues; 27% of EBITDA)
  - Sadales tīkls AS (LV)
- Transmission assets (5% of revenues; 15% of EBITDA)
  - Latvijas elektriskie tīkli AS (LV)

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Latvenergo generating power

	MW_{el}	MW_{th}
Plavinas HPP	894	-
Kegums HPP	240	-
Riga HPP	402	-
Aiviekstes HPP	0,8	-
Riga CHPP-1	144	493
Riga CHPP-2	832	1124
Liepaja cogeneration plant	2	10
Liepājas biomass boiler house	-	30
Kegums boiler house	-	4
Ainazi wind power plant	1	-

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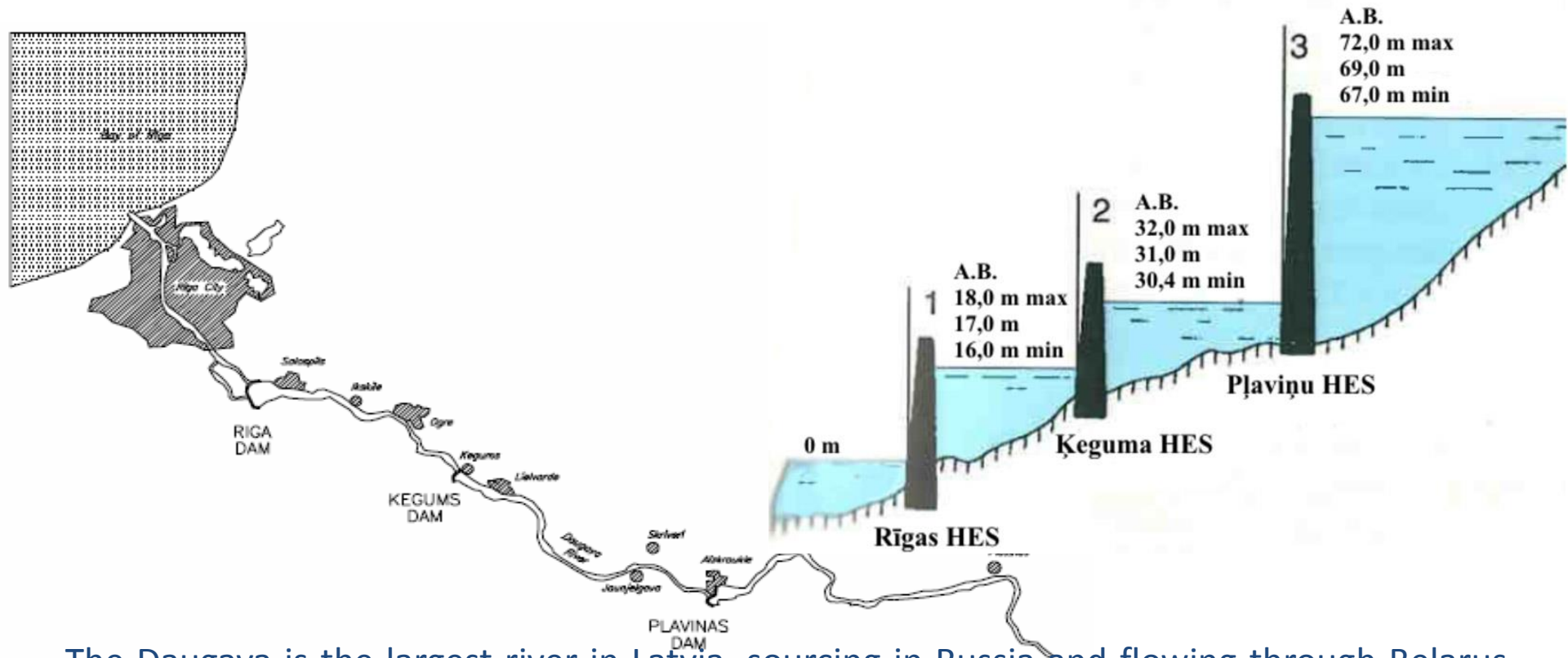
Daugava HPP cascade



The Daugava is the largest river in Latvia, sourcing in Russia and flowing through Belarus before it enters Latvia. Within Latvia it has a length of **250 km** between the eastern border and the capital city of Riga where the river enters the Gulf of Riga. The hydro-electric potential of the Daugava has been developed by constructing the dams at three sites; Pļaviņas, Ķegums and Rīga, all of which are owned by Latvenergo AS.

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Plavinas HPP

Installed capacity	884 MW
Entered into service	1968
Number of hydroelectric units	10
Turbine type	Francis
Maximum head	40 m
The length of the dam	4032 m
HPP discharge capacity:	
Total at maximum level (73.3 m)	12 600 m^3/s
Through turbines at maximum level (73.3 m)	3 030 m^3/s
Total at normal level (72 m)	10 550 m^3/s
Through turbines at normal level (72 m)	2 680 m^3/s
Maximum recorded discharge (1931)	8 380 m^3/s

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Kegums HPP

Installed capacity	264 MW
Ķegums HPP-1	72 MW
Ķegums HPP-2	192 MW
Entered into service: Ķegums HPP-1	1939
Ķegums HPP-2	1947
Number of hydroelectric units: Ķegums HPP-1	4
Ķegums HPP-2	3
Turbine type	Kaplan
Maximum head	14 m
The length of the dam	1978 m
HPP discharge capacity:	
Total at maximum level (33.1 m)	12 605 m^3/s
Through turbines at maximum level (33.1 m)	2 150 m^3/s
Total at normal level (32 m)	9 540 m^3/s
Through turbines at normal level (32 m)	2 150 m^3/s

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Riga HPP

Installed capacity	402 MW
Entered into service	1974
Number of hydroelectric units	6
Turbine type	Kaplan
Maximum head	18 m
The length of the dam	15 400 m
HPP discharge capacity:	
Total at maximum level (18.8 m)	13 100 m^3/s
Through turbines at maximum level (18.8 m)	3 470 m^3/s
Total at normal level (18 m)	12 040 m^3/s
Through turbines at normal level (18 m)	3 345 m^3/s

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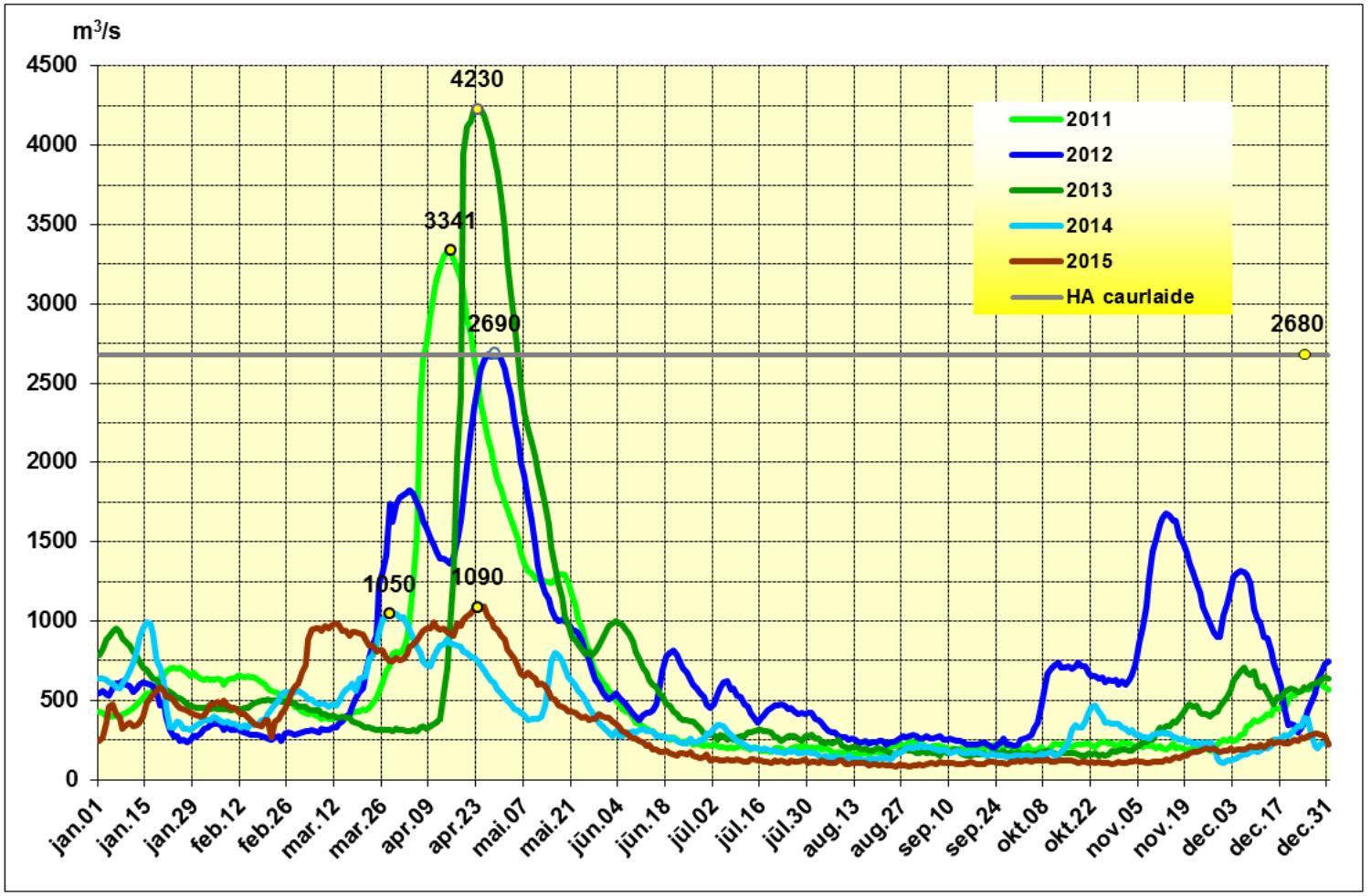
Hydroenergy of Belarus

- The water level of the River Daugava is affected by rainfall and snow in Belarus and Russia, where located ~67% of the total basin.
- Till 1991 in Belarus in operation was only 6 small HPPs with total capacity 6 MW.
- Scientists estimate that the maximum electrical power in Belarus entire HPP could reach 500 MW, but economically based are only 300-350 MW HPP construction.
- From 1991 till 2010 amount of small HPPs increase till 40 with total capacity 16 MW.
- In 17 december 2010 Council of Belarus Ministers made dessision start construction of 33 new HPPs with total capacity 102.1 MW.
- Till 2020 on river Zapadnaja Dvina (Daugava) planned build cascade of four HPP: Verhnedvinskas HPP (20 MW), Polockas HPP (22 MW), Bešenkoviču HPP (33 MW) un Vitebskas HPP (40 MW).
- Constraction of Vitebskas HPP performing company CNEEC (China National Electric Engineering Company). Constraction works started in 2013 and HPP is planned to put into operation in 2017.
- Constraction of Polocka HPP started in 2011 and it was expected to be completed in 2015, but in spring floods 2015 was interrupted protecting dike and flooded constraction pit. Currently expected time to complet works - end of 2016.

Daugava inflow

Plavinas HPP



Annual average inflow	
1976	353 m^3/s
2013	627 m^3/s
2014	377m^3/s
2015	354 m^3/s

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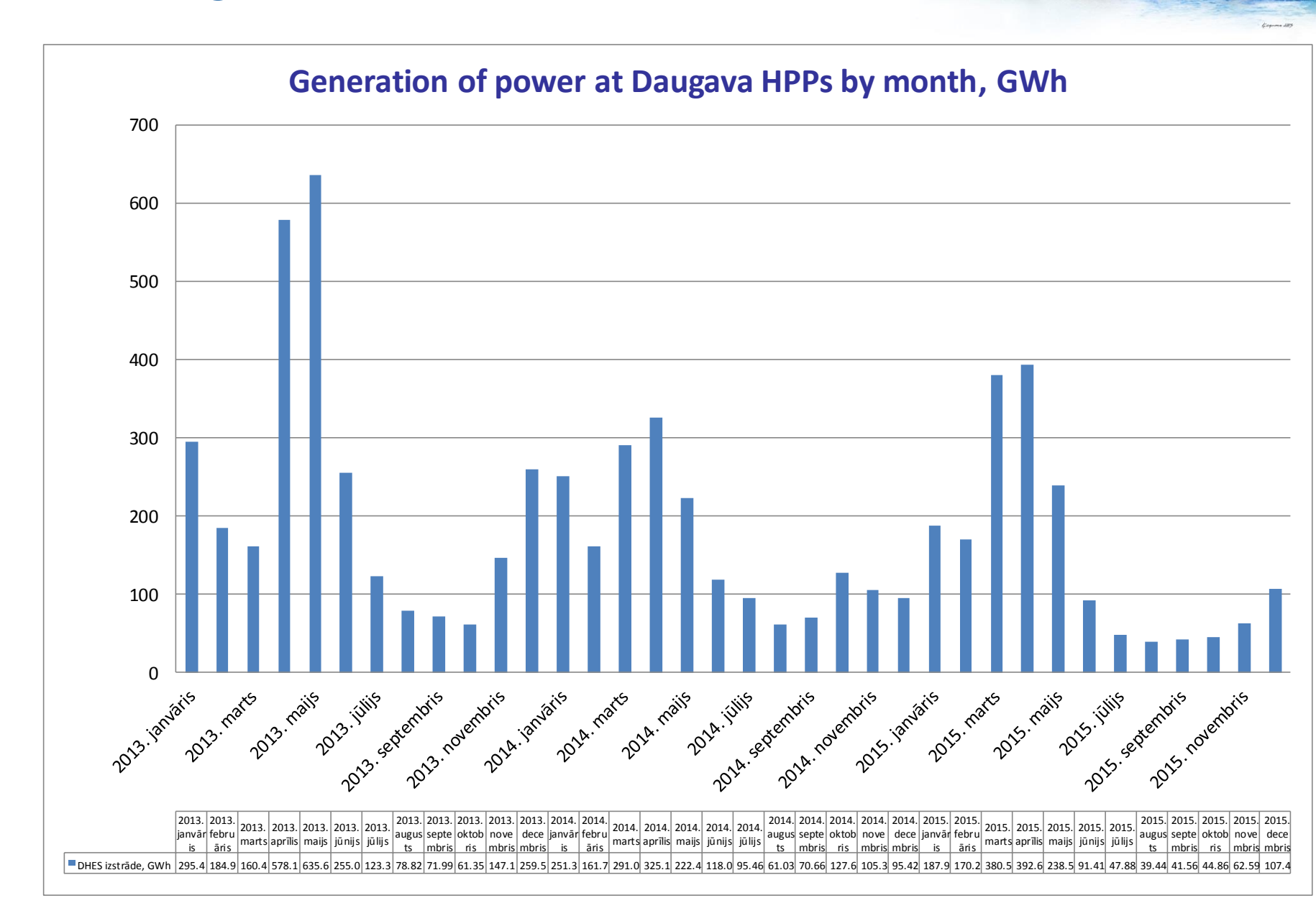
Power generation



	2013. janvāris	2013. februāris	2013. marts	2013. aprīlis	2013. maijs	2013. jūnijs	2013. jūlijs	2013. augusts	2013. septembris	2013. oktobris	2013. novembris	2013. decembris	2014. janvāris	2014. februāris	2014. marts	2014. aprīlis	2014. maijs	2014. jūnijs	2014. jūlijs	2014. augusts	2014. septembris	2014. oktobris	2014. novembris	2014. decembris	2015. janvāris	2015. februāris	2015. marts	2015. aprīlis	2015. maijs	2015. jūnijs	2015. jūlijs	2015. augusts	2015. septembris	2015. oktobris	2015. novembris	2015. decembris
DHES izstrāde, GWh	295.4	184.9	160.4	578.1	635.6	255.0	123.3	78.82	71.99	61.35	147.1	259.5	251.3	161.7	291.0	325.1	222.4	118.0	95.46	61.03	70.66	127.6	105.3	95.42	187.9	170.2	380.5	392.6	238.5	91.41	47.88	39.44	41.56	44.86	62.59	107.4

Latvenergo Group emergencies and crisis management system

- Latvenergo Group emergencies and crisis management system is established to provide early identification and effective management of Group company's in emergencies and crisis situations.

Cooperation in flood time

- Every year in Latvenergo Group its created flood commission that organizes and supervises the preparatory work, to ensure the success of the Group's activities during the spring floods.

Latvenergo readiness for floods

- Latvenergo readiness for floods: its carried out full equipment preparation and testing to generate all hydro resources in electricity during flood period.

- Latvenergo operational service has been prepared for qualitative and timely coordination of the work, decision-making and cooperation with State fire and rescue service.

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The legal framework for operation of Daugava HPPs – the main documents

Legal acts (LV and EU), Latvian Power Standards, Latvenergo AS instructions

Permits for using water resources for power generation in HPP are issued by state environmental authority - Regional Environmental Board (for each HPP)

Operational rules of Daugava HPP reservoirs – approved by Regional Environmental Board, discussed with other parties concerned (BIOR, municipalities etc)

HPP permit contains the following information:

- Limits for water levels upstream and downstream HPP (m abs.) (additonal limitations during fish spawning period)
- Allowed level fluctuations (m/day)
- Discharge capacity (m^3/s)
- HPP operation during maintenance works
- Monitoring requirements: water levels (measured), discharge (calculated according to the approved methodology and the Daugava discharge data)
- HPP operation and compliance with permit and other legal requirements is controlled by competent authority (Regional Environmental Board)

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Additional environmental improvement measures (according to legal requirements)

- Fish resource loss compensation – 1 035 000 EUR annually + additional payments for loss during HPP maintenance works (if water levels are lowered under normal operational conditions)
- The payments are used to reproduce different fish species (salmon, sea trout, pike perch, pike, vimba, whitefish, lamprey) in state fish-farms in Daugava river basin
- Latvenergo AS representatives participate in fish account comissions

- Strenghtening Daugava river banks – 1 452 260 EUR annually
- Strenghtening projects are performed by state companies, Latvenergo AS representatives participate in planning and commsioning of the projects

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Additional emergency spillway of Plavinu HPP (1)

Why needed additional emergency spillway in Plavinu HPP?

Plavinu HPP PMF (possible maximum flood):

- approved PMF of Plavinu HPP - **12 600 m^3/s** (probability 1 time in 10000 years);
- Discharge capacity of Plavinu HPP units and spillway at normal reservoir level 72.0m BAS-77 - **10 550 m^3/s;**
- In accordance with the international practice in case of large floods in calculations capacity through the HPP hydro units shall not take into account. At downstream elevation 42m BAS-77 units will stops working;
- In accordance with the international standards must be applied (n-1) law, that means that in case of large floods one of spillway gates don't work;
- at (n-1), discharge capacity of Plavinas HPP at NWL - **9593 m^3/s;**
- at (n-1) and don't work units, discharge capacity of Plavinas HPP at NWL - **6913 m^3/s;**
- Additional discharge capacity of Plavinas HPP at NWL - **3007** till **5687 m^3/s.**
- **Additional emergency spillway is necessary to increase dam safety of Plavinu HPP .**

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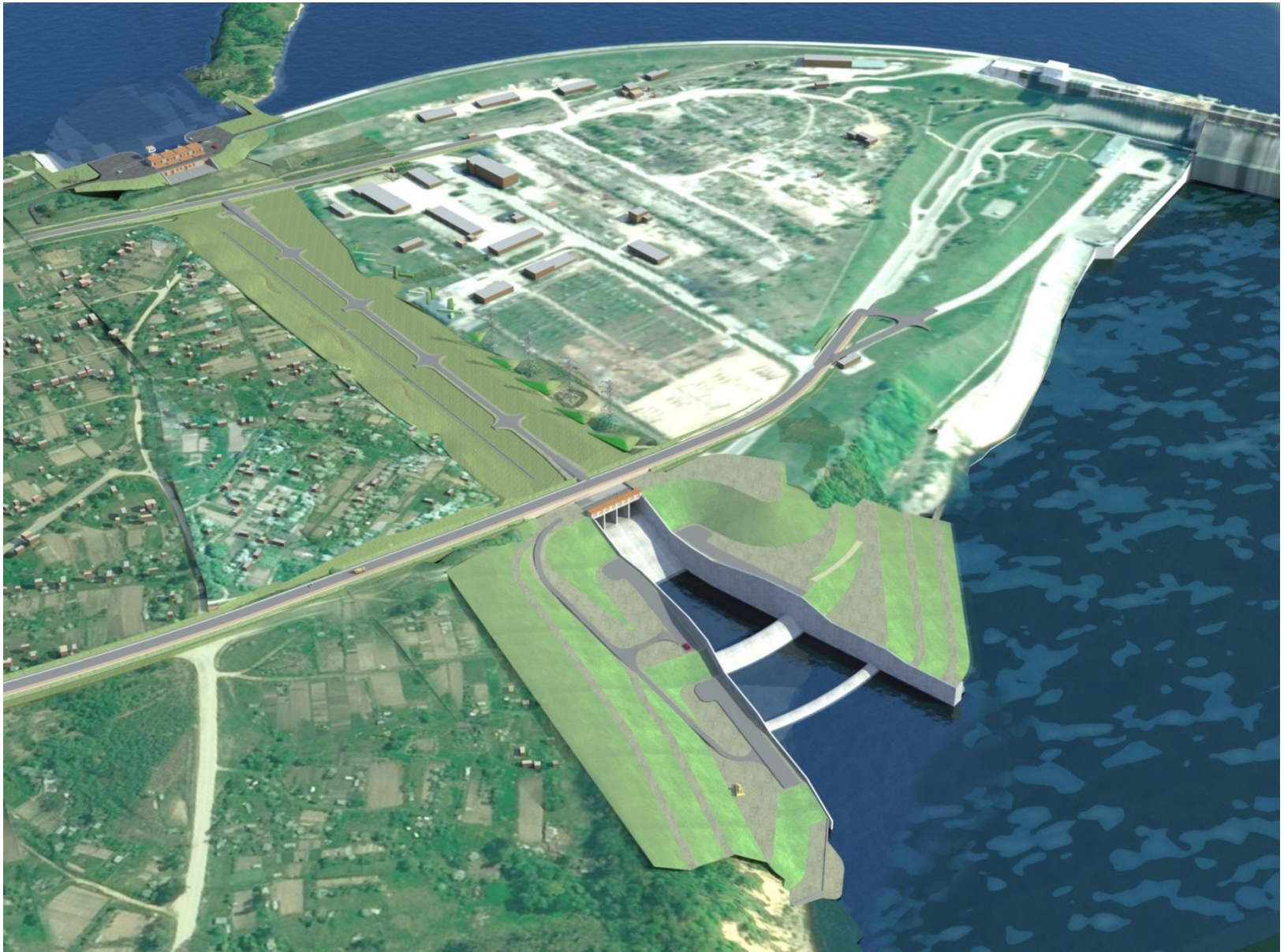
Additional emergency spillway of Plavinu HPP (2)



Questions?

www.latvenergo.lv

info@latvenergo.lv

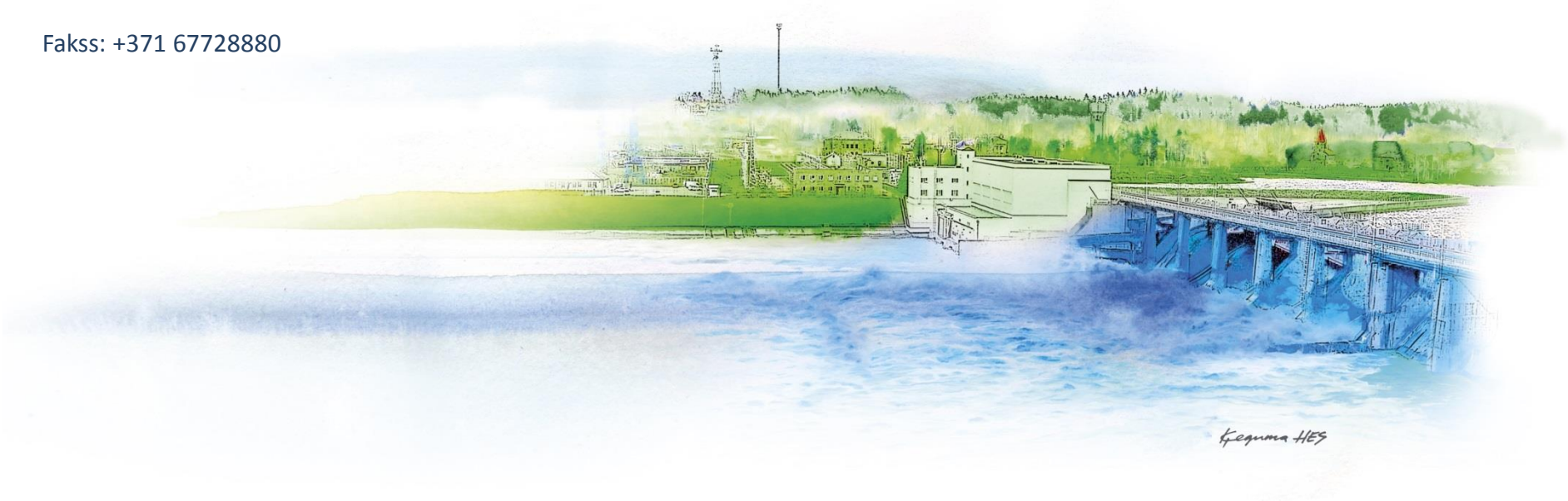
AS “Latvenergo”

Pulkveža Brieža iela 12, Rīga

LV-1230, Latvija

Tālrunis: +371 67728222

Fakss: +371 67728880



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