TESLA TECHNOLOGIES

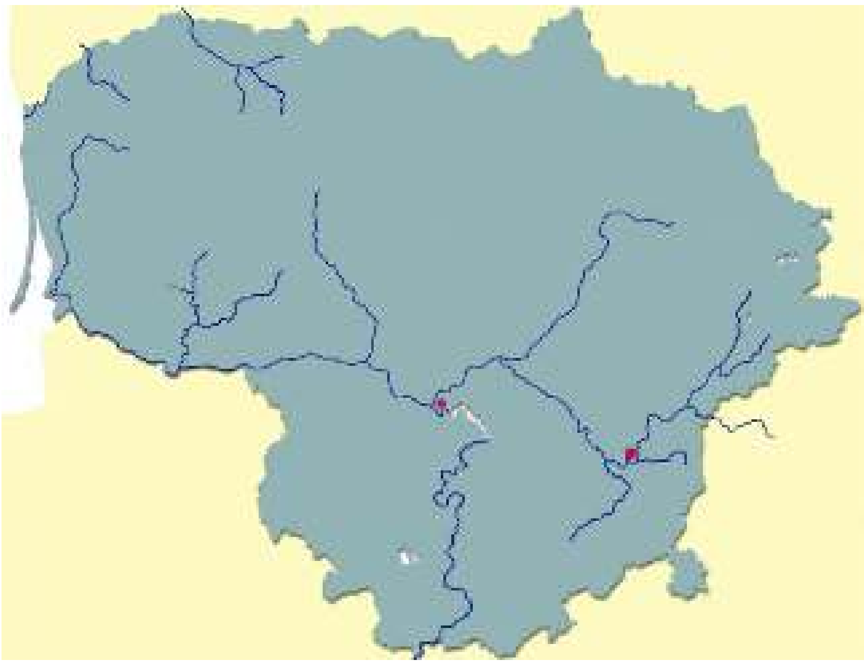
BRIDGE TO THE FUTURE

CASCADING HYDRO POWER PLANTS IN LITHUANIA

2019

Lithuania – Tesla Innovative Cascading Hydro Power Plants

- Lithuania has a surface area of 65.300 km²; it`s divided by Middle Lithuanian Lowland
- The Middle Lithuanian Lowland is a massive collector of surface waters that flow away to the river Niemen.
- The coastal areas of Lithuania, geography is hilly with a maximum height of 234 meters.
- South Eastern region is rich in hills with height up to 120 m, where the river Niemen enters from Belarus.
- East Lithuania is the highest area in the country with peaks as high as 294 m.
- With such topography, construction of classic hydropower plants is not beneficial despite the fact that electrical energy is in deficiency and expensive. There is a great necessity for renewable sources of energy.
- Tesla innovative cascading hydro power plants are the ideal technology in development that could be utilised for these unexploited resource



- Depicted is a significant part of Lithuanian rivers, with great potential, but utilised with only one classic hydropower plant.

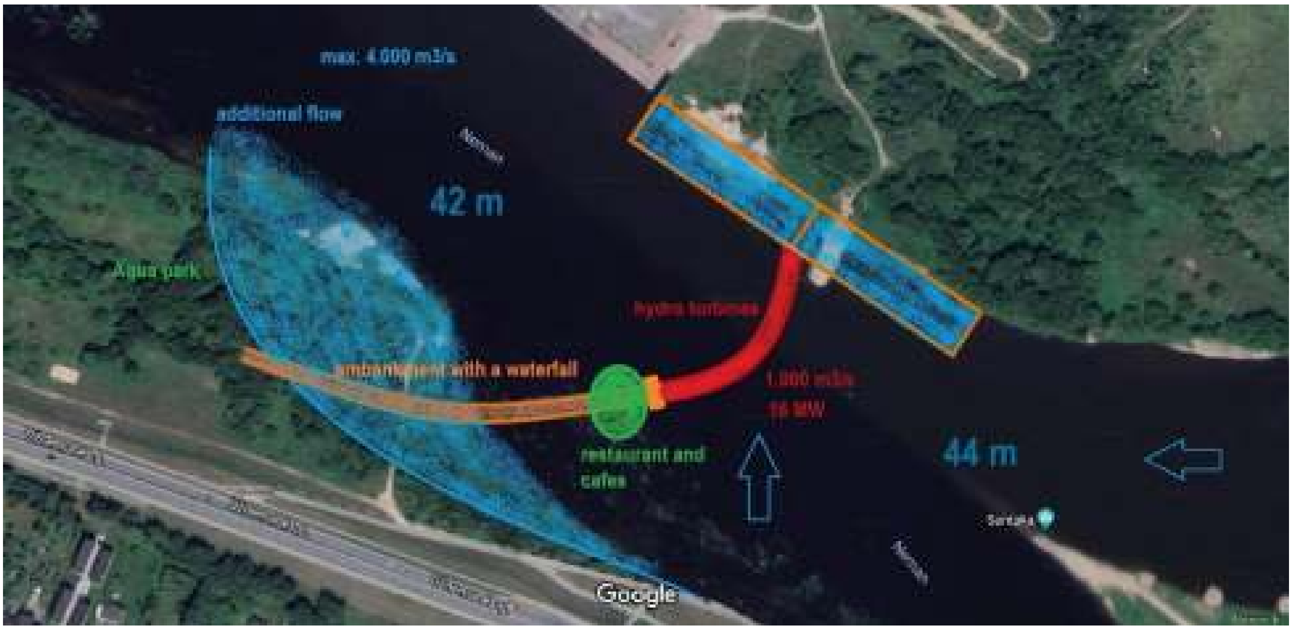
- Niemen River is 937 km long, from what 359 km + 116 km of flow belongs to Lithuania with a total circulation of 678 m^3/s
- In the middle part of Niemen River, on Lithuanian territory is a hydropower plant with an accumulation lake.
- The existing accumulation gives favourable parameters to utilise flow downstream and for stable work of future constructed cascading hydropower plants.

- HPP Kaunas has installed capacity of 4 x 25,2 = 100,8 MW
- HPP utilises the constant perennial flow of Niemen river, registered on this spot as 260 m^3/s,
- HPP uses a height of water column of 15 m
- The turbines use the total flow of 4 x 190 = 760 m^3/s
- The high water level is planned on additional 3.000 m^3/s overflow
- HPP Kaunas has produced in 2005 total of 363 GWh, while median production over multiple years is 350 GWh
- HPP utilises the height of water column of 1 m for installation of 6,72 MW generator
- Accepted parameter for construction of cascading HPP is 1 m for generator installation of 6 MW

- Below HPP Kaunas is planed cascading HPP on the confluence of rivers Neris and Niemen

- Existing water level in accumulation HPP Kaunas is on elevation grid point 58m ASL
- The water level in the riverbed of Niemen that levels work of HPP is on elevation grid point of 44m ASL

- The proven constant flow on the position of HPP Kaunas is 260 m³/s, with an installation of cascading HPP, this flow will be mainly utilised in peak demand for electrical energy
- The river flow will be stopped entirely during the night time, while water will accumulate for day usage.
- Niemen river accepts additional 418 m³/s of water from multiple tributaries
- This way, future cascading HPP below HPP Kaunas will have projected flow of 1.000 m³/s, where hydro turbines will have installed power of 16 MW on 2 m level drop
- The rise of water for 2 m is achieved in 2 to 3 hours, a time frame when the river is stopped in a controlled manner on the cascade
- Overflowing water is additional 3.000 m³/s to 6.000 m³/s independence of cascade position.



- The hydro turbines are in width of 100 m, with depth setup of 5 m and necessary setup of water line 2 + 2 m
- The bank is at length 200 m, with the walking platform and self-levelling waterfall for flood waters
- The viewpoint is located near main flow, above water, with a view of a waterfall and turbine location.
- Possibility to set up water park with series of water slides, water skiing, setup of stones create the sound of bubbling water, theme parks with benches and lighting, a place suitable for many possible investments.
- Multiple water slides will use filtered water, momentarily will release 5 m³/s to 10 m³/s of water.

- Unused potential if the level drop of 44 m, gives a possibility of installing 352 MW cascading HPP
- This part of river Niemen has the capacity to setup 16 up to 22 cascading HPP
- Cascading HPP will utilise water column of 2 m to 3 m, following natural relief and height of riverbank.
- With 1% of Niemen river flow, it's possible to release 70.000 ships thru all future cascading HPP
- Technically, we can achieve a waterway to Belarus up to Vilnius and other places inside of Lithuania.
- Visible river deposits will not be visible such as is current case.

- River Neris has an unutilized level drop of 110m with median flow of182 m³/s which gives the opportunity to set 55 cascading HPP with total installed power of 170 MW

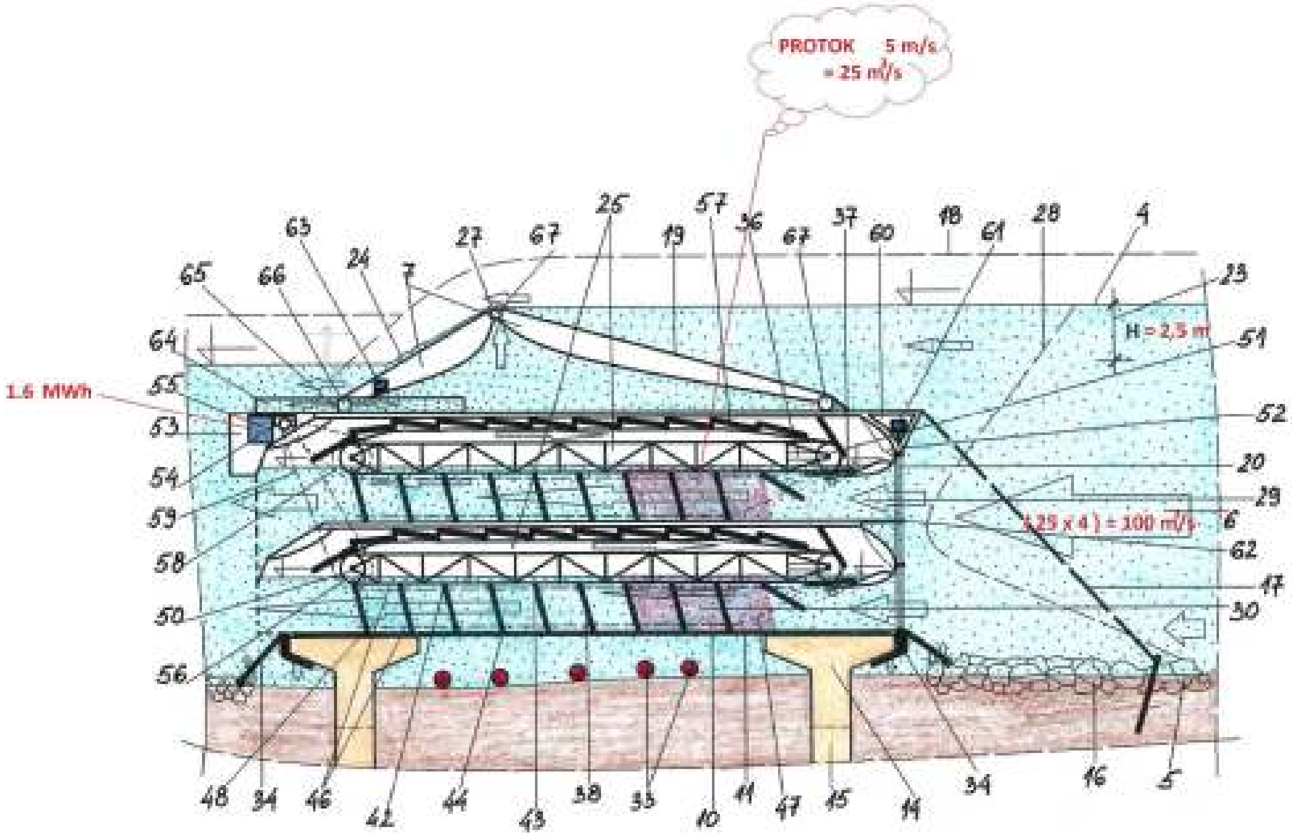
- The building of 500 MW cascading HPP will last 3 to 5 years, the period after standardisation of the technology.
- The warranty period for usage is up to investment return.
- Estimate ROI estimated at 5 to 7 years.

- On smaller water flows it is possible to install a couple of hundred cascading HPP with an established power of 100 kW up to 500 kW
- Median flow of river Niemen has an unutilized potential of 24 m of the level drop, which gives the possibility to install 12 cascading HPP with 12 MW each, in the total of 144 MW
- In total, Lithuania can host up to 800 MW cost effective cascading HPPs

Tesla Innovative Cascading HPP, future references for building purposes

- Utilization of existing river bed without legal obstacles for building, 100% in government ownership
- Production of factory modules that are installed in the river bed, standardised construction of cascading HPPs.
- HPP's can be constructed on all types of riverbanks, even marshlands.
- The additional benefit is melioration of river banks, new flora and flauna, oxygenation of water flows
- Acquiring stable river bed without the possibility of water meandering, useful for urban development next to the river
- Largest Tesla cascading HPP, i.e. 30 MW is built in 6 months – fast building
- The additional benefit is that river can open for continual river traffic, as the technology aligns natural surges during excess rainfall or snow defrosting. Future flooding risks are lowered to potentially zero with the implementation of the Tesla Cascading HPP.
- Existing accumulations can store the flow entirely during the night, so it has full potential during daily peak demands. This regime is suitable to HPP with accumulation; production is mainly during daytime or as necessary.
- The Ecology of the river is thoroughly respected, relying on natural building materials and latest methods of harmonizing natural resources. Tesla Cascading HPP monitors the water levels to the centimeter, meaning that fish hatcheries can be created in the water flow. Depending on the location many possibilities are open to create recreational areas, that ensure the communities have a unique encounter with Mother Nature.

Tesla Innovative Cascading Hydro Power Plant



In this solution, hydropower plant can operate as local generator connected to a local power grid.

Production of electrical energy from cascading hydropower plant is realised in this way: Pylons (15) are fixed to the river bed (5), on them are laid band foundations (14). Two cascading turbines are interconnected (10) and put on band foundations. (14).

Achieved water height difference “H” (23) creates pressure to cascading power plant. Regulators (20), gradually leak water (6) towards pipes (29) of the turbine with rate of inflowing water (6) Water (6) in pipes (29) accelerates, blades (38) of the turbine utilise it to convert to mechanical energy. The pressure of trapped air (25) prevents water penetration (6). This way, flowing water (6) is directed thru pipe (29) of the turbine where is utilised on turbine blades (38).

The turbine blades (38) on return path are moving thru air almost without any undesirable environment resistance. The direction of the movement of turbine blades (38) is achieved by “U” profiles (46) and guides (47). Such relation is balanced and stabilised with overflowing (27) water over the barrier (19). In this way, we accomplish stable RPM on electric energy generator (55).

In total, pipes (29) have several times bigger volume than planned utilisation of water flow (6) per second in the river. This enables that water flow potential (6) is maximally utilised almost to the turbine standstill by using software control.

When the cascading plant is in operation, one can observe overflow of a small amount of water like a waterfall, while the majority of water is directed thru turbine. Favourable cascade is regulated by embankment made of metal net filled with local stone. The reduction is not necessary, and energy is transferred directly to a generator shaft.

Wind Generation	Tesla Cascading Hydro Power Plant
Building cost approx. 1 million eur/MW	Building cost approx. 1 million eur/MW
Building place has potential, partly limited with favorable places where wind draft has variable direction and intensity	Building place has unutilized potential, at the moment there is no cuncurent technology for utilizing lowland rivers, technology is uniqe with utilization of steady intensity of water flow
No land acquiring, location is used with existing roads	No land acquiring, location is used with existing roads
Bird migration is disrupted, physically and by acoustical vibrations that influence people as well	Does not disrupt flora and fauna. Nature can undisturbedly flourish and develop with favorable water melioration.
Vibrations can damage material, wind generators are not protected from extreme winds that can tear blades and cause short circuit incineration of the generator plant.	Vibrations in water are damped, overflow sound positively and relaxing influence people. Flash floods does not influence plant
Environment is not favorable for tourism industry	Environment is favorable for tourism, weekend zones and populated places with land melioration, sport activities and industrial zones as additional building project.
Has no additional economical effect but energy production	River bed is regulated for flash floods, cascades slow floods when needed, water flow can be speed up as required.
No additional economical effect, no possibility to store energy	Cascading plant situated in chain can accumulate water during night for utilization over daytime.
Optimal and economical speed is above 6 m/s	Optimal and economical speed is above 3 m/s
Adding produced energy from series of locations	Adding produced energy from series of locations or single connection to a local electricity grid similar to gas generator.
Source of potential wind energy is variable in given time interval. It's more intense on the night when requirement for energy is less	Source of potential energy is constant, concentrated in daytime interval when requirements are greater
Yearly production with 1 MW plant is average 2.600 MWh, more by night.	Yearly production with 1 MW plant is average 2.600 MWh, more by day.
Yearly production on better locations with 1 MW is 3.000 MWh	Yearly production on better locations with 1 MW is 7.000 MWh if bank channels diminish part of water potential.
Lowest building cost is 1.000.000 eur per MW, If production is at rate of 2.600 MWh, investment has no economical effect, part of produced energy needs to be stored, results in economical loss.	Lowest building cost is 1.000.000 eur per MW, If production is at rate of 2.600 MWh, energy is momentarily transported to a consumer, cascading system accumulates energy ny night, lowers danger from flash floods, creates better waterway, land melioration, improves ecology...

In proportion to the water flow in the observed river (m³/s) !

Water flow in the river	Height of the cascade	1.5 m	2 m	2.5 m	3 m	3.5 m	4 m
5 (m³/s)			0.07 MWh	0.08 MWh	0.10 MWh	0.12 MWh	0.14 MWh
10 (m³/s)		0.10 MWh	0.14 MWh	0.17 MWh	0.21 MWh	0.24 MWh	0.28 MWh
20 (m³/s)		0.21 MWh	0.28 MWh	0.35 MWh	0.42 MWh	0.49 MWh	0.56 MWh
30 (m³/s)		0.31 MWh	0.42 MWh	0.52 MWh	0.63 MWh	0.73 MWh	0.84 MWh
40 (m³/s)		0.42 MWh	0.56 MWh	0.70 MWh	0.84 MWh	0.98 MWh	1.42 MWh
50 (m³/s)		0.52 MWh	0.70 MWh	0.87 MWh	1.05 MWh	1.22 MWh	1.40 MWh
60 (m³/s)		0.63 MWh	0.84 MWh	1.05 MWh	1.26 MWh	1.47 MWh	1.68 MWh
70 (m³/s)		0.73 MWh	0.98 MWh	1.22 MWh	1.47 MWh	1.71 MWh	1.96 MWh
80 (m³/s)		0.84 MWh	1.12 MWh	1.40 MWh	1.68 MWh	1.96 MWh	2.24 MWh
90 (m³/s)		0.94 MWh	1.26 MWh	1.57 MWh	1.89 MWh	2.20 MWh	2.52 MWh
100 (m³/s)		1.05 MWh	1.40 MWh	1.75 MWh	2.10 MWh	2.45 MWh	2.80 MWh
150 (m³/s)		1.57 MWh	2.10 MWh	2.62 MWh	3.15 MWh	3.67 MWh	4.20 MWh
200 (m³/s)		2.10 MWh	2.80 MWh	3.50 MWh	4.20 MWh	4.90 MWh	5.60 MWh
250 (m³/s)		2.62 MWh	3.50 MWh	4.37 MWh	5.25 MWh	6.12 MWh	7.00 MWh
300 (m³/s)		3.15 MWh	4.20 MWh	5.25 MWh	6.30 MWh	7.35 MWh	8.40 MWh
400 (m³/s)		4.20 MWh	5.60 MWh	7.00 MWh	8.40 MWh	9.80 MWh	11.20 MWh
500 (m³/s)		5.25 MWh	7.00 MWh	8.75 MWh	10.50 MWh	12.25 MWh	14.00 MWh
600 (m³/s)		6.30 MWh	8.40 MWh	10.50 MWh	12.60 MWh	14.70 MWh	16.80 MWh
700 (m³/s)		7.35 MWh	9.80 MWh	12.25 MWh	14.70 MWh	17.15 MWh	19.60 MWh

Cascade Hydroelectric Power Plant produces electricity in one-hour mode (MWh) !

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