



# EFFICIENT

JÉGER project –Hail damage repelling system

So to say, manipulating weather conditions in the economy.

Controlsoft kft.

# When did it begin?

## A little bit of history

- In 1946. Dr. Bernard Vonnegut carried out cloud seeding under laboratory circumstances, creating rain and snow fall from artificial cloud.
- Media at that time reported about artificially controlled weather.
- It was discovered quickly that in reality it is much more difficult to carry out this phenomenon than under laboratory circumstances and probably it is not a very good idea to intervene into order of mother nature.
- In 1960 different researches were carries out under the supervision of the CIA, of course in full secrecy.
- It was effectively used during the Vietnam War, this was called „Operation Popeye” between 1967 and 1972.
- In 1977 an international convention forbade the manipulation of weather for military purposes.



Bernard Vonnegut is experimenting with silver iodide smoke in GE's lab



Rain making equipment on the US Air Force's WC-130E transport aircraft used in Vietnam

# Nowadays

- Civilian rain generation emerged as a separate industry and nowadays it is used in one way or another in 52 countries.
- The biggest player is China, where artificially generated rain is used to support irrigation activities during the dry season or to wash the contaminated air of large cities.
- Up until today, scientists are arguing about its rate of efficiency.
- One thing is for sure. It is working.
- Hail damage prevention is the by-product of rain generation.



Manufacturing of hail damage repelling rockets filled with silver-iodide in Russia.



A silver-iodide, sodium-chloride and calcium-chloride dosing unit is being fixed on the wings of a plain in India.

# How does it work?

- Hail develops in special atmospheric coincidences from smooth rain, precisely when the so-called wet temperature of the air reaches zero degree between 2200 and 2800 meters.
- The bottom line is that if a cloud is just at the right height and the temperature is also perfectly ideal, then the water droplets that condense from the vapor will have time to freeze but will also not melt by the time they fall onto the ground: hence the hail is made ready.
- We can intervene into this process by injecting some materials into the clouds that will boost the rate at which ice crystals are formed. The result: formation of a lot more ice but in smaller pieces that melt back perfectly into water before reaching the ground. According to our current knowledge, silver iodide is the most suitable material to achieve this purpose because its crystal structure is very similar to ice.



The two basic ways for hail damage prevention: the dangerous clouds must be attacked from above and / or from below.

# What is the situation in Hungary?

- The „rocket” system was in use from the 60’s till 1990 with more or less success.
- In 1991 a hail damage prevention system was launched in Baranya, Somogy and Tolna counties that did not function with planes and rockets but with evaporation stations.
- The seeding of upward air movement uses the easiest possible solution for sending silver-iodide into the clouds, since the warm air before storms moves towards the upper air layers, hence the upward moving moisture will reach the place of ice formation being already saturated by the reagent material.
- At which efficiency rate is it working?



Airplane spraying is dangerous and requires constant readiness.

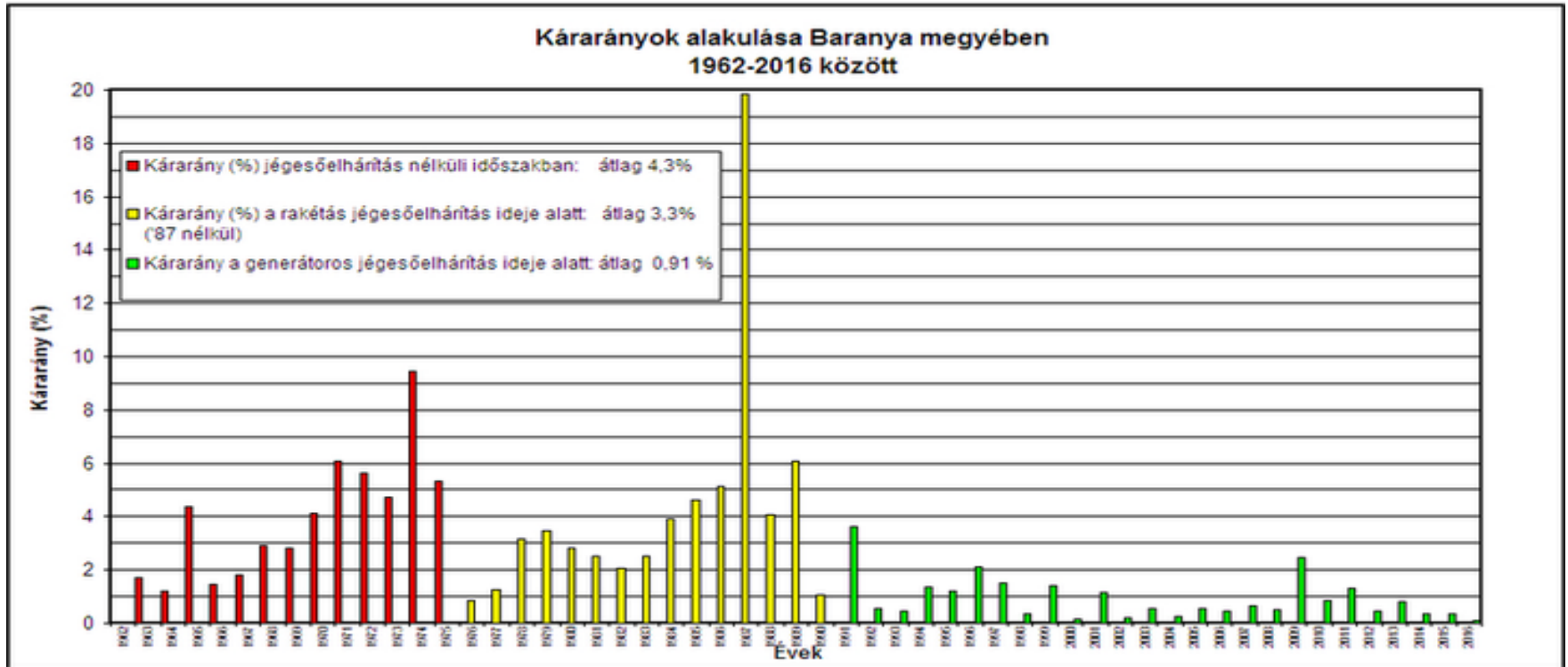


Rocket dispersion is inaccurate and very polluting.

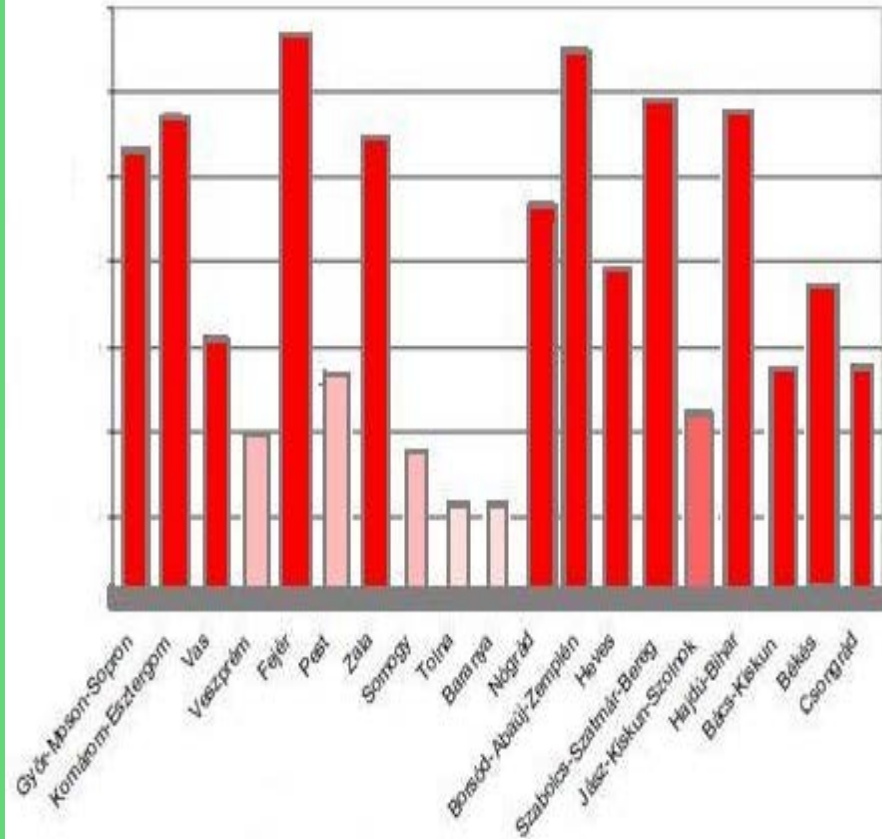


Evaporation is the most efficient solution and can be well automated.

# Evolution of damage rates in Baranya county



- Rate of damage between 1962-1976 (there was no hail damage repelling system): 4,3%
- Rate of damage between 1976-1990 (preventing system in place using rocket technology): 3,3%
- Rate of damage between 1991-2006 (manual, ground-generator based hail damage repelling system): 0,91%
- It can be seen from above, that the rate of damage is at about 70%.



Based on data from 2008, hail related damages in counties, where a repelling system is installed are much lower than in counties with no such systems in place.

# What will happen with all that silver? Environmental pollution?

- Yes, it will get into the ground and from there to nature and wildlife but what quantities are we talking about?
- 1 liter of silver iodide solution per hour is evaporated from a station into the air. Such a small quantity is also sufficient to make huge changes in the atmosphere.
- Measurements everywhere show that weather manipulation does not change the minimum concentration of silver that is naturally occurring in the soil or groundwater even when we are talking about decades.



Hail damaged corn field near Kecskemét in May 2013.



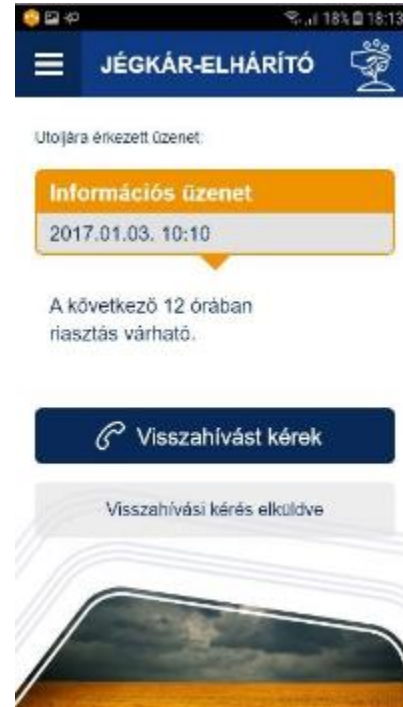
# Nowadays, in Hungary

- The National Chamber of Agriculture launched the nation-wide hail damage repelling system in 2018.
- The system is made-up of 986 ground generators (222 in automated and 764 in manual operation)
- The automated ground generators and the SCADA centre that is responsible for the supervision of the system was designed and installed by Controlosft Ltd.
- The center is managed by a webSCADA 6 process control system, while the automated generators are run by Schneider M221 PLCs.
- The central SCADA system is in continuous connection with the weather forecast system of the National Meteorological Services, it receives the alerts from this system. These alarms are then transmitted to the appropriate ground generators that are located in the particular alarm zone and to the operators of the manual ground generators with the help of an Android application.



Manual ground generator

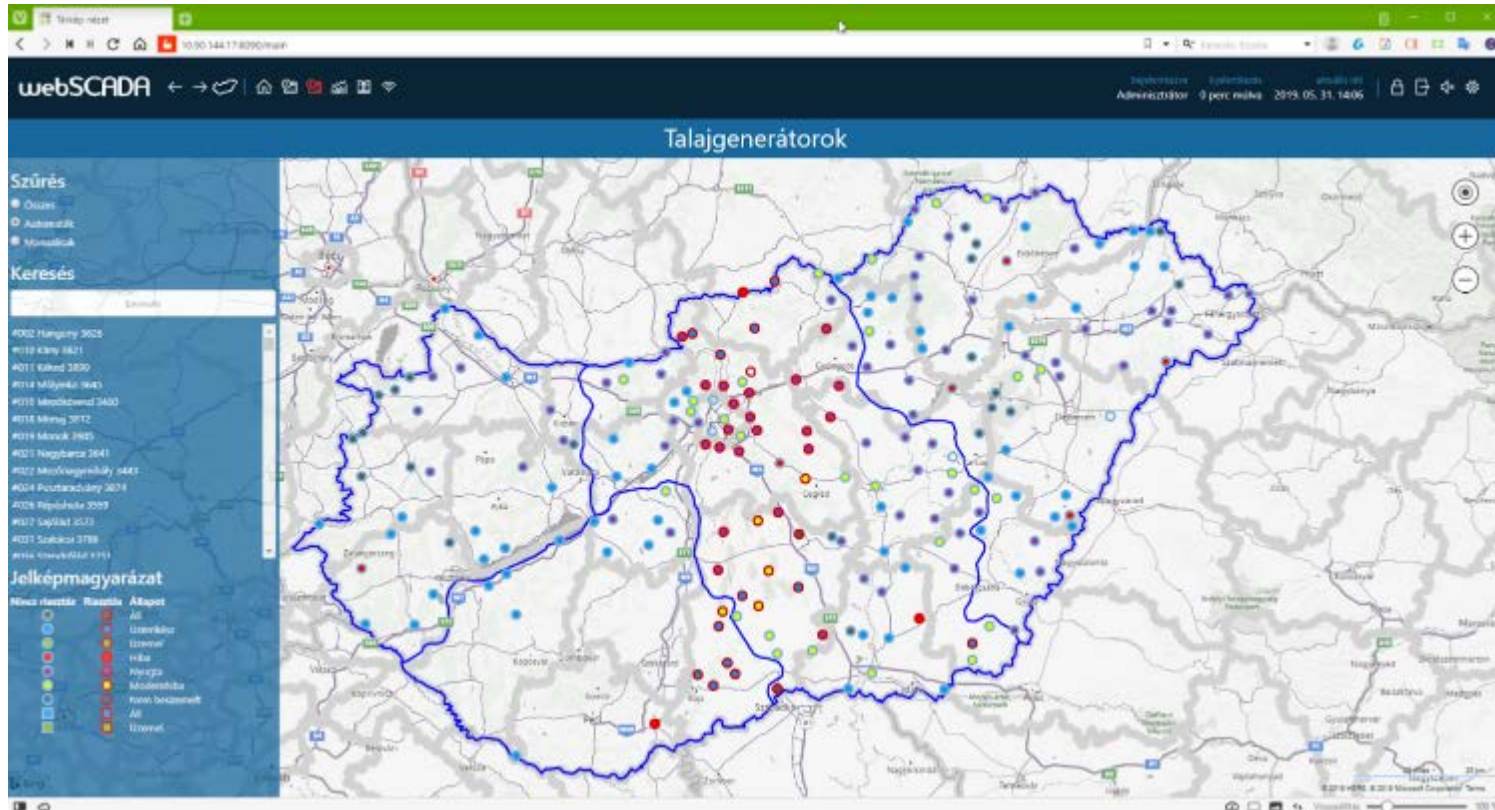
# The Android interface of the hail damage repelling system







# The centre of the hail damage repelling system – automated generators



- The webSCADA 6 software communicates with the automated ground generators via GPRS routers.
- A multi-level, hierarchic command release system is in place:
  - Station-level: Each station can be launched independently.
  - Groups: Stations can be organized into groups, possibility to launch a group of generators.
  - Regional: The stations are centrally classified into four regions, possibility to launch these regionally selected generators.
- There is no difference between the command that is issued to the manual and to the automatic stations, only the starting mode distinguishes them.
- The automatic stations are launched by a Schneider M221 PLC immediately after the command is issued.
- The manual generators are launched by „Uncle John” (sorry for the choice of name ;-), of course also immediately after the command is issued.

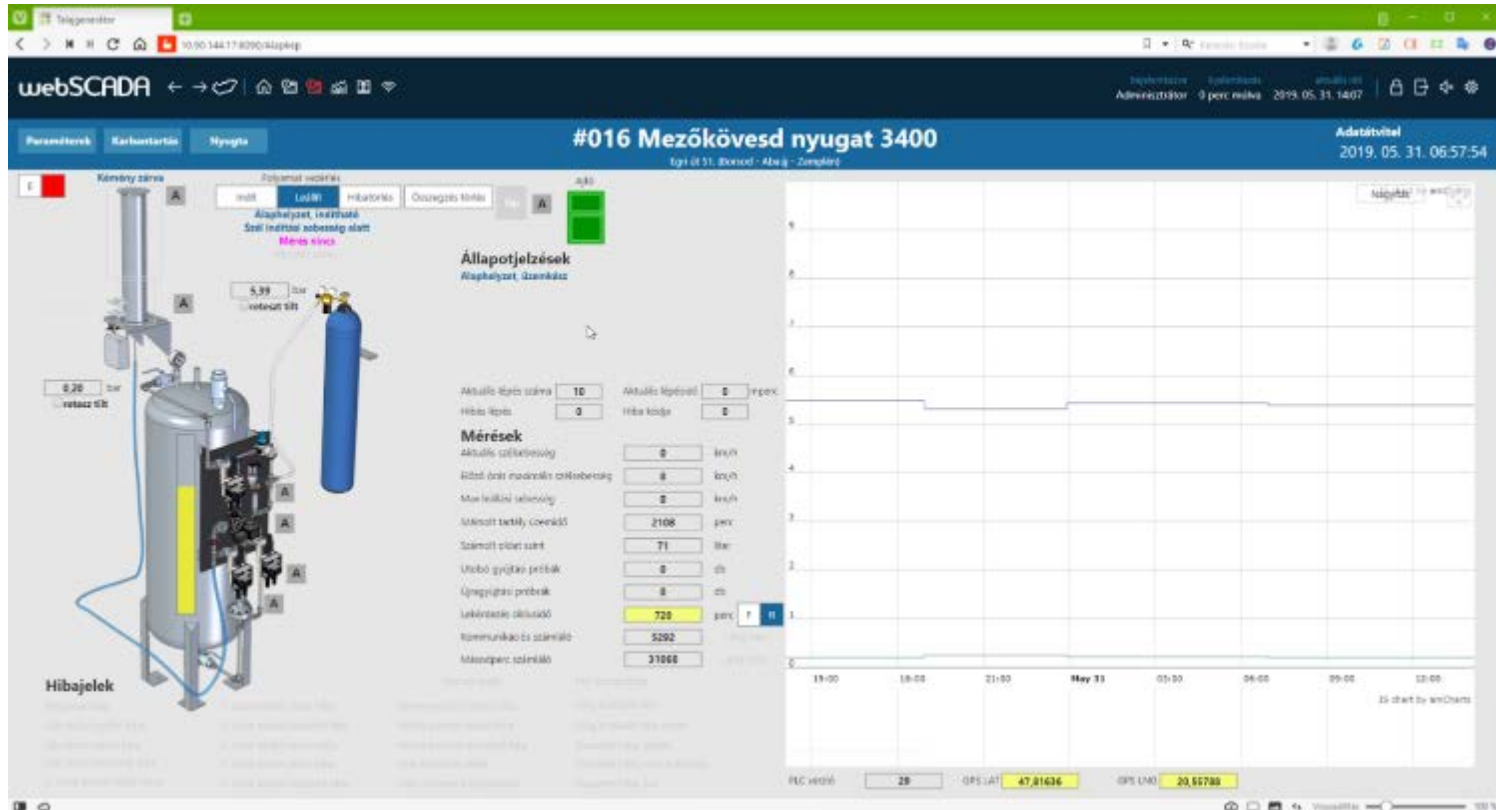


Automated ground generator

# The automated generators



# The centre of the hail damage repelling system – automated generators





# The centre of the hail damage repelling system – manual generators

The screenshot displays the webSCADA interface for a hail damage repelling system. The main title is '#001 Hangács 3795'. The interface is divided into several sections:

- Navigation:** Buttons for 'Indítás' (Start), 'Leállítás' (Stop), and 'Élelmennyelzés' (Status Check) are located above the 3D model.
- 3D Model:** A detailed 3D rendering of the manual generator, including a large cylindrical tank, various pipes, valves, and a blue gas cylinder.
- Adattábla (Data Table):** A table listing system parameters.
 

Művelet	Állás
Hozzájárulás	33,051304
Szűrőszűrő	48,288101
Teljesítés	Hangács
Kapcsolás	3795
Utca	Szomorvölgy tere
Házszám	1
Magyar	Borsod-Abaúj-Zemplén
Regio	6441-Magyarország
- Üzemeltetők (Operators):** A table showing operator status.
 

Teljes név	Élelmennyelzés
Állás	igen
	nem
	nem
	nem
- Üzenetek (Messages):** A table of system messages.
 

Élelmennyelzés	Üzenet típusa	Érvényesség ideje	Üzenet szövege	Magika fogadás ideje	Vízszállítás ideje	Szűrő	Kiállítás	Teljesítés
✓	Dőrejelzés	2019.05.31. 13:00:00	A következő 13 órán belül várható	2019.05.31. 13:01:26	2019.05.31. 13:00:57	Rendben	CMFZ	87%
✓	Dőrejelzés	2019.05.31. 07:00:00	A következő 8 órán belül várható	2019.05.31. 07:01:10	2019.05.31. 07:00:56	Rendben	CMFZ	88%
✓	Dőrejelzés	2019.05.30. 18:00:00	A következő 12 órán belül várható	2019.05.30. 18:02:58	2019.05.30. 18:03:01	Rendben	CMFZ	89%
✓	Dőrejelzés	2019.05.30. 13:00:00	A következő 13 órán belül várható	2019.05.30. 13:16:42	2019.05.30. 13:16:45	Rendben	CMFZ	79%
✓	Dőrejelzés	2019.05.30. 07:00:00	A következő 8 órán belül várható	2019.05.30. 07:00:56	2019.05.30. 07:01:11	Rendben	CMFZ	86%
✓	Riasztás	2019.05.30. 00:30:54	Kapcsolás a generátor	2019.05.30. 00:32:23	2019.05.30. 00:33:41	Rendben	CMFZ	94%
✗	Dőrejelzés	2019.05.26. 18:00:00	A következő 18 órán belül várható				CMFZ	
✗	Dőrejelzés	2019.05.26. 13:00:00	A következő 13 órán belül várható				CMFZ	
✓	Riasztás	2019.05.26. 06:16:16	Kapcsolás a generátor	2019.05.26. 06:16:51	2019.05.26. 06:16:56	Rendben	CMFZ	86%
✓	Dőrejelzés	2019.05.26. 07:00:00	A következő 8 órán belül várható	2019.05.26. 07:01:28	2019.05.26. 07:01:43	Rendben	CMFZ	70%

# Summary

- The system became operational in 2018. Already in its first year it had fulfilled all expectations.
- However, it should be emphasized that this is not hail elimination but a hail damage mitigating system.
- The goal is to have more automatically and less manually operated generators in the future.
- In 2019, we connected to the weather forecast system of the National Meteorological Services, so the whole technology works according to Industry 4.0 concepts, which means that computers are communicating with computers, leaving out the need of any human intervention and hence helping the daily work of the operators.

Thank you for your attention!

## RESULTS OF 2018

	Average for years 2015-2017	2018	Ratio
<b>Reported hail damage (ha)</b>	<b>57 183</b>	<b>22 524</b>	<b>39,39%</b>
<b>Ratio of hail damage out of all damages</b>	<b>33,03%</b>	<b>12,62%</b>	<b>38,21%</b>
<b>Number of stormy days</b>	<b>23</b>	<b>39</b>	<b>169,57%</b>
<b>Number of lightninings</b>	<b>1 717 487</b>	<b>2 917 760</b>	<b>170,28%</b>

The network started in what was considered to be an extraordinary year, yet the numbers speak for themselves.

# A project that the whole country can be proud of - Grand Award of Innovation 2018

