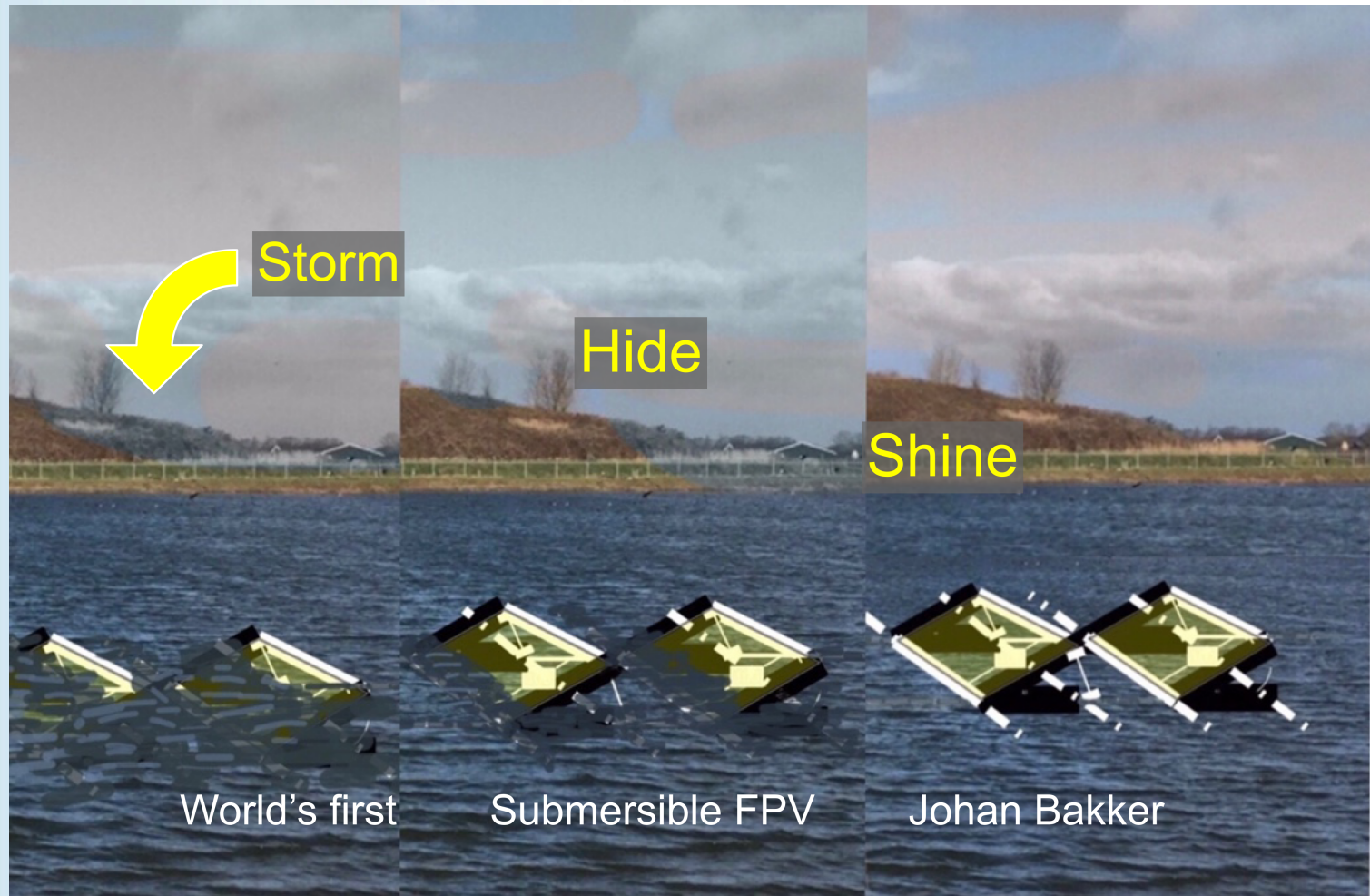


wonderlijk water  
waardevol werk



Waterschap  
Rivierenland



Storm

Hide

Shine

World's first

Submersible FPV

Johan Bakker

# Hide and Shine

- Heavy storm: ca. 3 days 'switch off' SUB (submersing) / year



- Wheater OK: 262 days SUR (surfacing) for yield



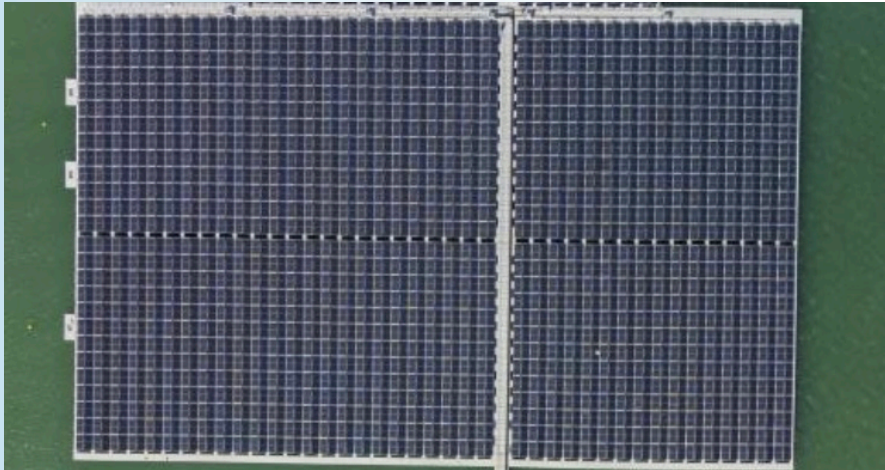
- Easier than offshore: 24/7 switch on, salt, high waves

wonderlijk water  
waardevol werk



Waterschap  
Rivierenland

# *Inland, shallow water, open design*



**Ecology-**  
**Less wind risk**



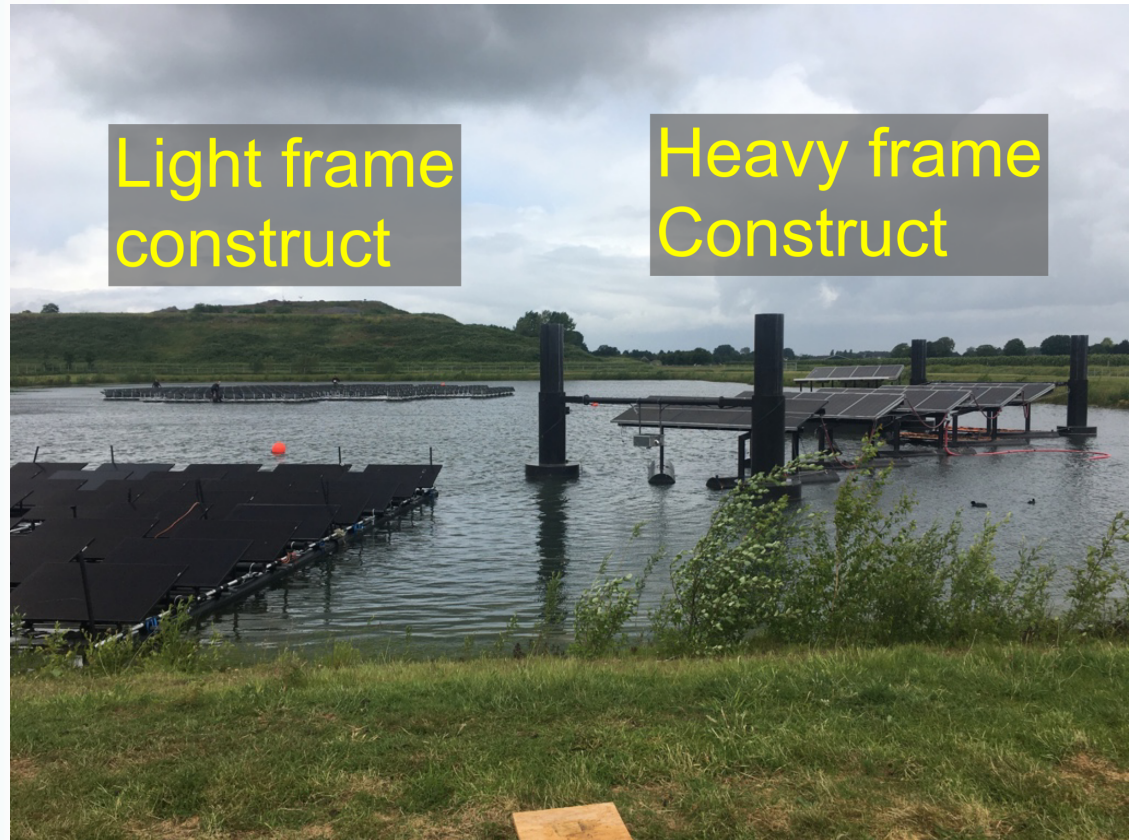
**Ecology+**  
**More wind risk**

**Ecology+ Less wind risk, when submersible**

# *Storm Safe, present value, LCA*

**INNOZOWA 1:**  
Open design,  
heavy construct

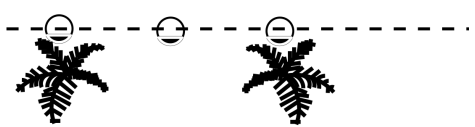
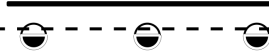
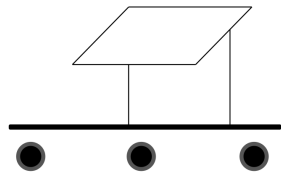
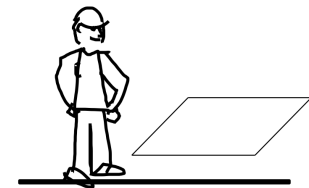
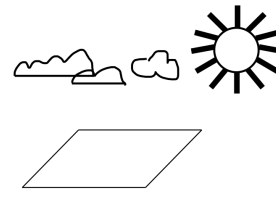
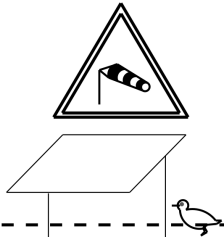
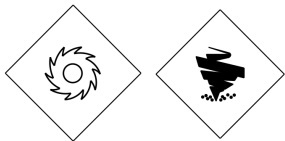
**INNOZOWA 2:**  
Submersible,  
light construct,  
biobased construct



## ***'Hide and Shine' Submersible ?? Submersible !***

- Light weight construct yes, more open design, and submerge when wind / storm
- Less anchoring, because of submersing
- Less storm risk, longer lifespan
- Flexible buoyancy when fouling, hanging crops, black ice, hail
- Less rubbing of components (microplastic, wear)
- More security (insurability)
- No 'nail biting' every hurricane, Beaufort 11, heavy gusts

## Hide And Shine: flexible buoyancy



Always safe when  
submersing

'High Heels', Vertical  
Orientation, Open  
Structure.  
Partially submersing

Floating and  
ballast

Max. floating when  
fouling, working,  
hanging crops

wonderlijk water  
waardevol werk



Waterschap  
Rivierenland

# Start with 'Professional tinkering' -Discovery.



# -Develop

HAS.ipynb

Bestand Bewerken Bekijken Invoegen Runtime Tools Hulp Laatst bewerkt op 15 dec. 2020

+ Code + Tekst

```
68 axes1.legend()
69 axes1.margins(0.5)
70
71 draw_circle_comp2 = plt.C
72 draw_circle_air2 = plt.Ci
73 axes2.set_title('Y float
74 axes2.set_xlabel('[mm]',
75 axes2.set_aspect(1)
76 axes2.plot([-y_float[0]/2
77 axes2.add_patch(draw_circ
78 axes2.add_patch(draw_circ
79 axes2.margins(0.5)
80 axes2.legend()
81 plt.show()
82
```

The balance could not be res...

X float dimensions

Y float dimensions

```
[ ] 1 import numpy as np
2 import matplotlib.pyplot as plt
3 from scipy.optimize import fsolve
4
5 # Define the expression whose roots we want to find
6
7 a = 0.5
8 R = 1.6
9 def expo(input):
10 out = 1.0 - np.exp(input)
11 return out;
12 func = lambda tau : R - (expo(-tau))/(expo(-a*tau))
```

## *Hide and Shine raft*

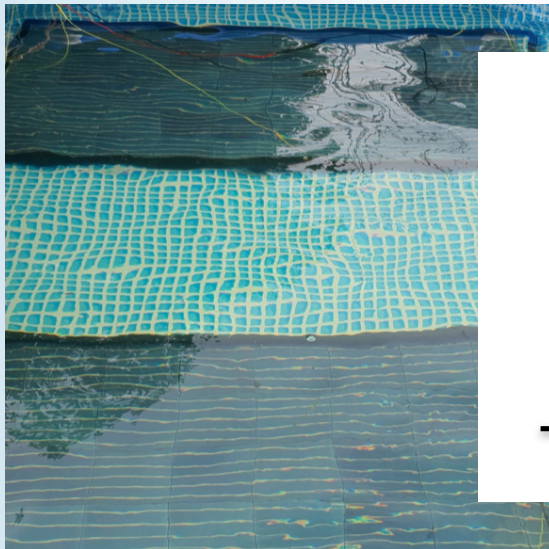
- Develop and demonstration
- Light weight 48 solar panels, 10 kg
- Frame for the time being, Aluminium
- Buoys, for time being HDPE
- Test program
- Construct
- Behavior in wheater
- Pumping
- First results +





## PV

- Yes, it already exists
- Waterproof (housing) solar panels, junction boxes, connectors, inventors
- Similar to IP68+
- Partners want to produce special stuff

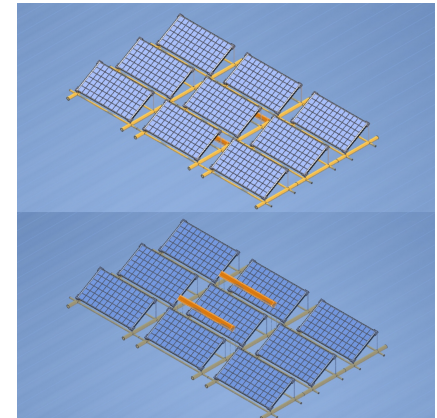


**Het totaal aantal uren dat de zonnepanelen onder water hebben gelegen bedraagt:**

Van	3-2-2021	tot	5-2-2021	:	<b>48</b>	<b>uur</b>
Van	22-2-2021	tot	26-2-2021	:	<b>100</b>	<b>uur</b>
Van	1-3-2021	tot	5-3-2021	:	<b>96</b>	<b>uur</b>
Van	8-3-2021	tot	12-3-2021	:	<b>102</b>	<b>uur</b>
Van	15-3-2021	tot	19-3-2021	:	<b>99</b>	<b>uur</b>
Van	22-3-2021	tot	26-3-2021	:	<b>100</b>	<b>uur</b>
Van	29-3-2021	tot	7-4-2021	:	<b>214</b>	<b>uur</b>
<b>Totaal</b>					<b>:</b>	<b>759 uur</b>

## ***Conclusions and remarks***

- Submersible: new, complementary approach
- Investments cost effective
- Less risk and maintenance
- Reliability, failure mechanisms, inherently safe
- Submersing and surfacing in quarters of hours
- Scalable : rafts 50-100 solar panels, 10-20 rafts
- Smart remote control
- Smart but simple
- Modular from factory



World's first light weight and storm safe  
submersing and surfacing  
Floating Solar FPV raft

Hide  
and Shine



Storm  
'Switch off'  
Hide



wonderlijk water  
waardevol werk



Waterschap  
**Rivierenland**

wonderlijk water  
waardevol werk



Waterschap  
Rivierenland

**Fight water  
or  
make use  
of ?**

Photo:  
[sublimepools.  
net](http://sublimepools.net)



wonderlijk water  
waardevol werk



Waterschap  
Rivierenland



**Submersible  
Floating Solar  
Netherlands**

**Johan  
Bakker**