SUNTEAN

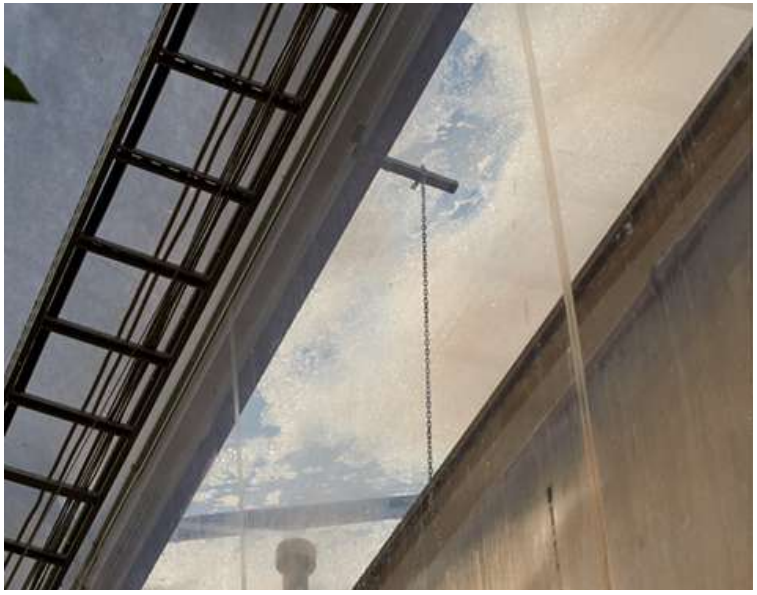
..protean buildings for a thriving future

A provider of SolaRoof Technology Solutions & **AlgaeRoof** Integration

SolaRoof creates progressive building envelope functionality for exceptional performance and experience.

Protean: Resembling the Greek God Proteus in having a varied nature or ability to assume different forms; displaying great diversity or variety; versatile.

The enabler is **Soap Bubbles**! 3% added once a year in the amount of water needed to fill the cavity with foam. This liquid is best heat-transferred with a larger thermal mass (pure water, fish, algae..).



The 2 key dynamic SolaRoof principles and their function:

Liquid Bubble Insulation (LBI)

Insulation - A minimum 50cm cavity is filled with low cost liquid soap bubble insulation when needed and can be removed in minutes for full sunlight penetration.

Shading - Reduce light by 50-70%; absorb solar radiation that is removed in the next bubble regeneration.

Liquid Solar Technology (LST)

Heat Collection - The building envelope becomes a solar collector by circulation soap liquid alone or together with bubble insulation according to needs.

Liquid Heat Storage - Liquid thermal mass placed beside, beneath or within the building. Energy needs correlates to size of the liquid thermal mass.

Cooling - water circulating in the the cavity absorb to store or remove to solar gain.

Humidity Control - At the correct temperature this liquid created controlled condensation of transpiration and other humidity.

Algae production - Algae culture can circulate in an additional cavity beneath the primary functions of SolaRoof to ensure right level of sunlight and temperature for specific algae strains.

HOW IT WORKS

Cost effective dynamic building envelope with extreme energy efficiency, maximum sunlight, solar collection possibilities, integrated cooling and humidity control for flexible use.

2 things happen inside this min 50cm cavity:

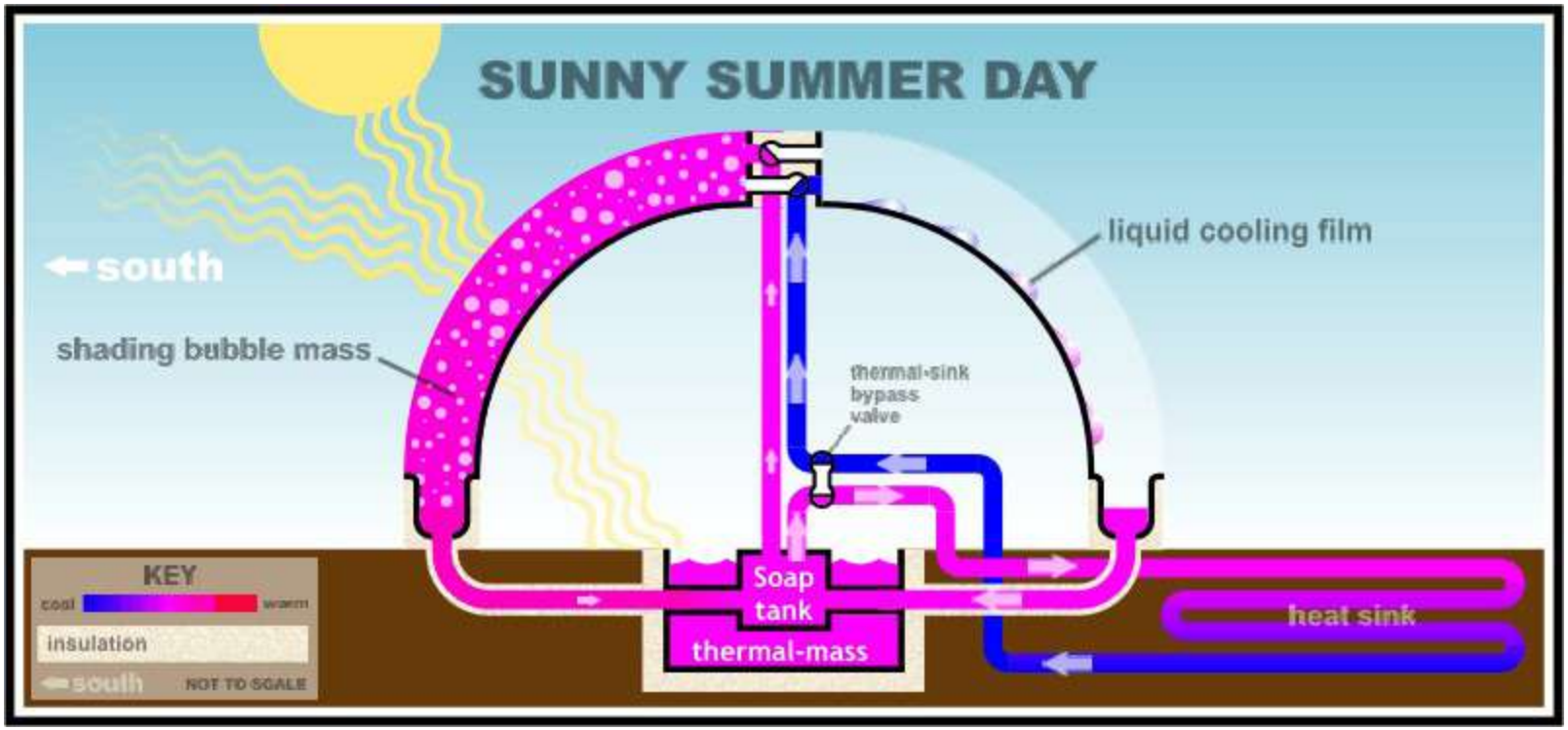
1) It can be filled with LBI, when needed, to provide a super efficient insulation which still lets plenty of the sunlight though. The bubbles can be applied with different temperatures for additional effect to keep heat inside or outside, and be renewed to reestablish the highest level of this effect as temperature barrier. (U-value of 50cm is 0,05*)

2) The same soap liquid circulate together with the bubbles or alone, inside the same building envelope, to capture solar gain for removal and storage, for humidity control and as an effective cooling mechanism.

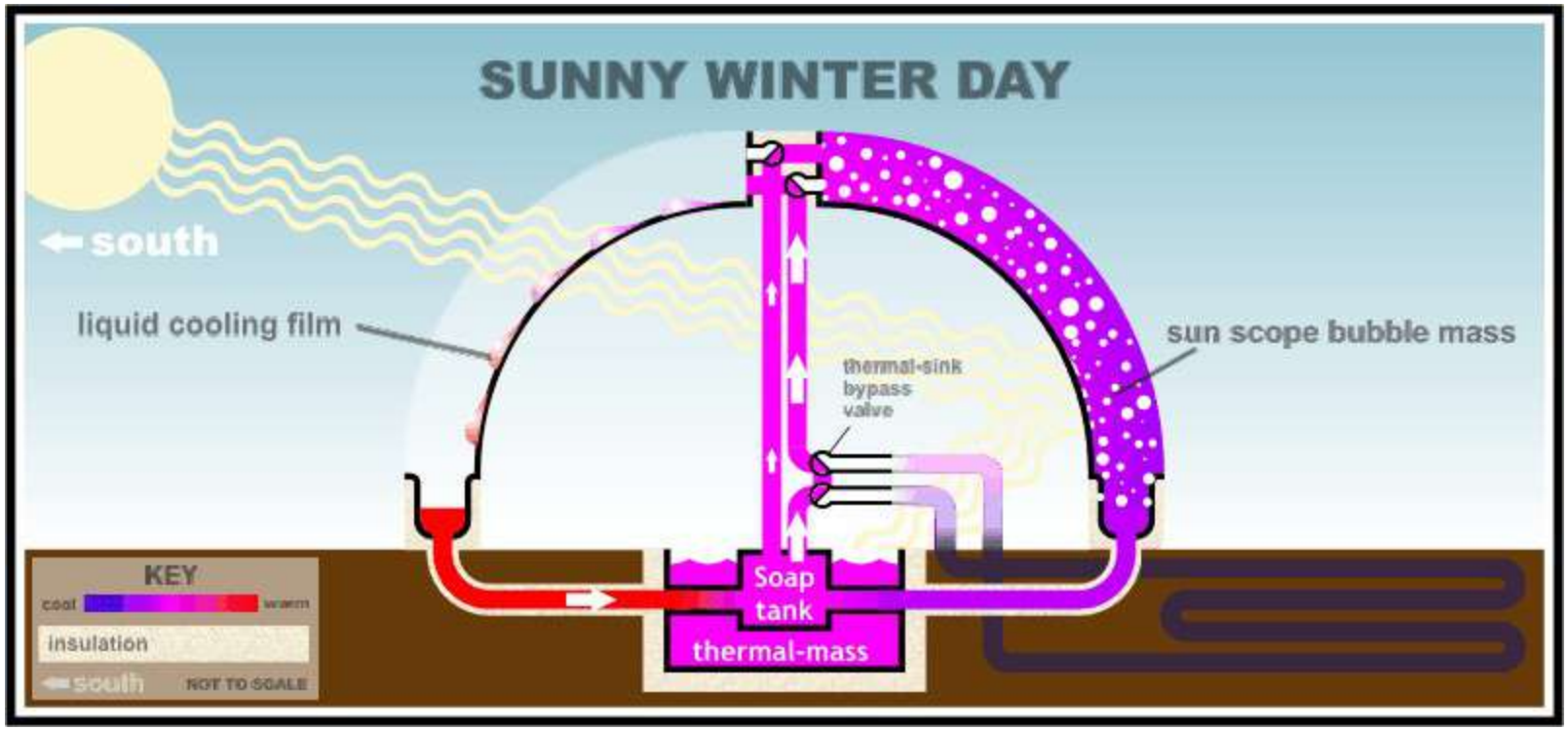
Algae culture can circulate beneath the SolaRoof to provide additional cooling if needed for the purpose of the building and/or level to optimal light level with flash exposure in a vertical growing setup.
Thus present a cheap way for local algae production for many purposes.

*this is the same as air, but bubbles counter out the convection effect which is significant at that depth.

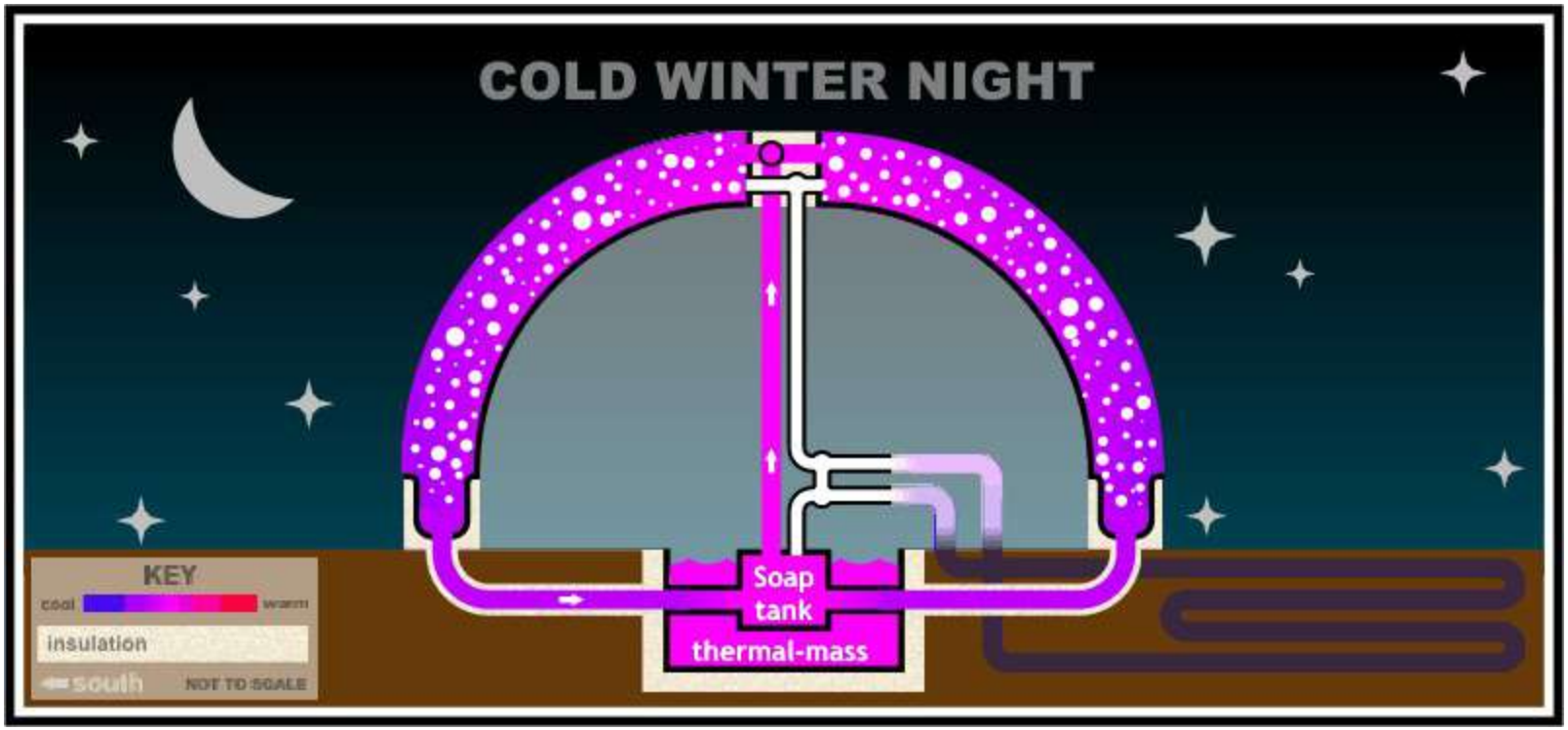
To illustrate:



Shading to the South when and if needed.
Cooling and dehumidification in the North only;
also beneath the bubbles in the South;
or Liquid Cooling Technology only in the whole building envelope.

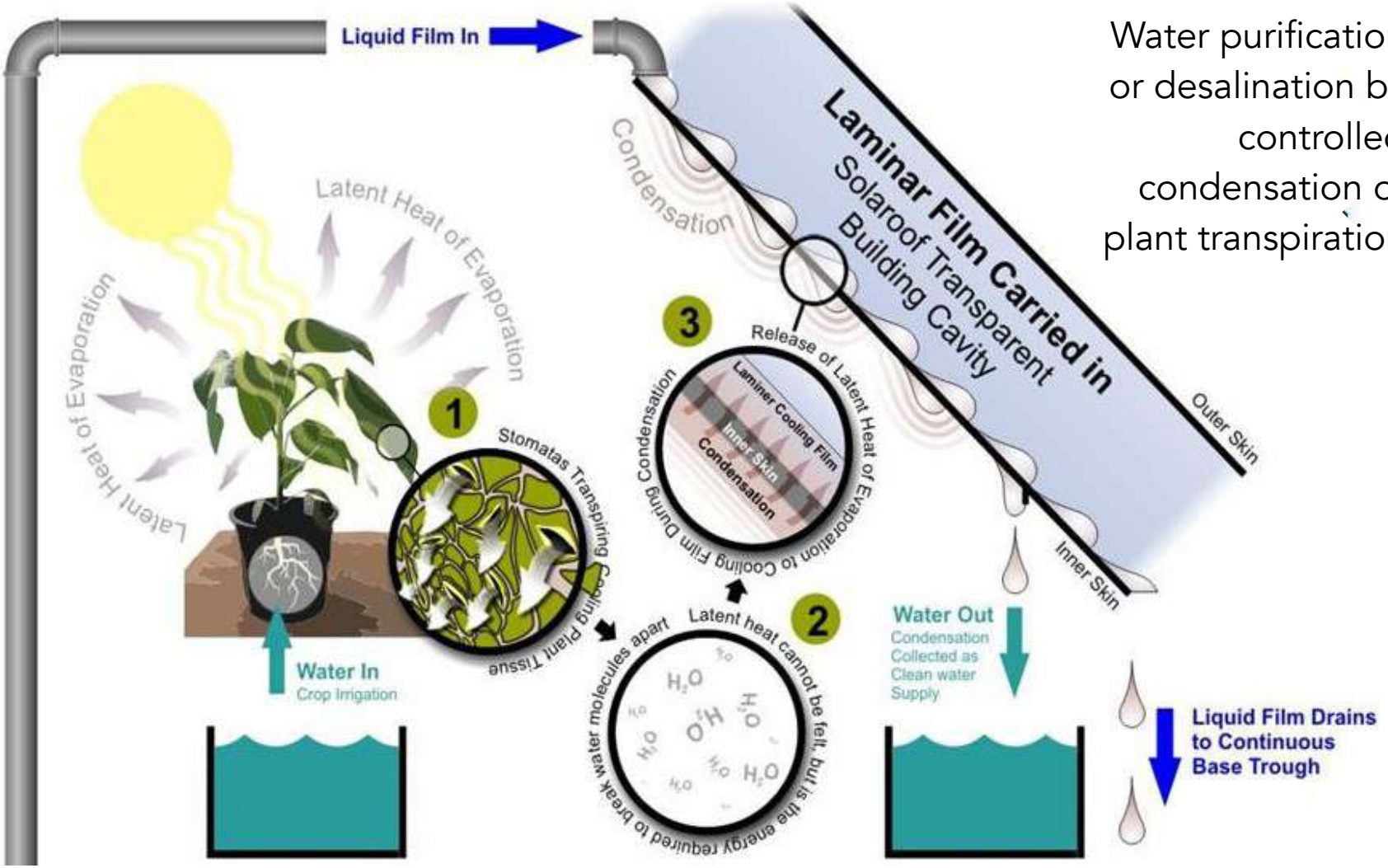


Liquid Solar Technology in the South.
Insulation and light reflection in the North cavity.
Also LST in the North if needed for humidity control.



Liquid Bubble Insulation in the whole building envelope.
Bubble renewal before cold air reached inner layer.
LTS only in warm night is hot climates to cool the thermal mass.

Cooling + Solar Energy Removal/Storage



Water purification or desalination by controlled condensation of plant transpiration

Conversion of conventional tunnels to SolaRoofDIY

Pilot at Poznan University, Poland built for the project **Food2Waste2Food** (2012-15) with funding from the EU program Eco Innovation:

80% reduction in energy needs in winter compared to standard Dutch commercial greenhouses.

Same results are achieved in other demonstrations projects!

Winter temperature:>-30C

Year round production of tomatoes in Sem without use of Liquid Cooling.
Closed Greenhouse production (without ventilation) of tomatoes for four years in Alberta had 80% reduction of the overall energy needs with only bubbles in the roof.

Alberta, Canada

Sem, Norway

Videolink to news rapport of the BBBLS greenhouse in Sem

https://tv.nrk.no/serie/distriktsnyheter-oestafjells/201812/DKTE97121018/avspiller

BBBLS did not properly integrate Liquid Solar Technology. They rapport a 80% reduction in heating needs in the winter, but naturally ran into issues with cooling, dehumidification and air exchange in the summer without LST or possibility to open the roof for normal ventilation.

Their demo is still a good indication of the insulation capabilities of SolaRoof.

There are several SolaRoof school demos in Norway (without LST)

at the Life Science University NMBU, Ås; Vestsiden Upper Secondary, Kongsberg and Sydskogen Primary School, Asker.

Video of the school greenhouse at Vestsiden Ungdomsskole in Kongsberg by TG Electro & Automasjon

https://www.youtube.com/watch?v=CdBFxPJJDVU

SolaRoof is perfect match with hydroponic as large thermal mass improve the energy balanse

Yields in Lettuce Production

SolaRoof can enable

Controlled Environment Agriculture (CEA)

CEA =

CLIMATE CONTROL WITHOUT VENTILATION

NB! This requires a large liquid thermal mass (0,5-2,5m3/m2), connection to an external heat sink or access to cool water.

- Remove CO2 wastage (normally over 60% escapes through ventilation).
- Efficient dehumidification by controlled condensation. Restricting access for insects /pest entering the greenhouse.
- CEA enable capturing of transpiration.

Main Applications for SolaRoof Buildings:

- Greenhouses/Agriculture: Plants; fish; algae; livestock.

Ideally, a combination of plants/fish/algae is beneficial as large amount of liquid thermal mass help store the heat collected by LST

- Architecture/Building Construction: Building envelope (with or without normal windows); roofs; walls; atriums; skylights..
- Water Purification: LST at a sufficiently low temperature enable Closed Production and controlled condensation of clean plant transpiration.
- Floating Structures (easily enable a large liquid thermal mass)

To specify potential applications:

- Low emission greenhouses
- Integration into many types of affordable and luxury residential homes
- Flat and sloped roofs
- Rooftop greenhouse / Winter Gardens
- Livestock buildings
- Semi-permanent Insulated Tents / Emergency Shelters
- Hydroponic-, Aeroponic- and Aquaculture production
- Closed Environment Agriculture (CEA) for protected production under difficult conditions (water issues, pest, pollution and climate change)
- CEA to remove CO2 wastage (60%) in commercial greenhouse production
- CEA for water purification and desalination through controlled condensation of plant transpiration (more efficient than reverse osmosis)
- CEA for laboratory level cleanrooms
- CEA for food production that captures and reuse plant transpiration
- Cost effective way to cultivate algae

SolaRoof is a perfect fit with fluoropolymers!

Fluoropolymer, one being ETFE (Ethylene tetrafluoroethylene), are transparent materials known for its exceptional properties. It is lightweight and highly durable material that offers various benefits in different applications. ETFE is widely used in architectural, construction, and engineering projects for its remarkable performance characteristics. It is a popular choice for applications where high light and UV transmission are required

Ceres Aquaponic Design

Normal 5 layer ETFE = U-vlaue 1
With SolaRoof, only two layers of ETFE will give a much lower value depending on the thickness of the cavity >0.025
1R / Inch (50cm = 0.05 / 1m = 0.025)

Skylight by Vector Foiltec

Recapping:

SolaRoof is an dynamic building system with
highly cost-effective & efficient climate control methods
for significant energy reduction and climate production
for all life with daylight level sufficient for use as greenhouse.

*

SolaRoof enables extremely low U-value
by circulating liquid soap bubbles and liquids
inside a transparent building envelope.

But that's not the whole story because our insulation is dynamic and is temperature controlled and
therefore does much more than static insulation.
In addition we can control the radiant temperature of our billing envelope and use the bubbles for shading.

*

SolaRoof is suitable for most buildings and budgets,
offering flexibility of use, design and materials.

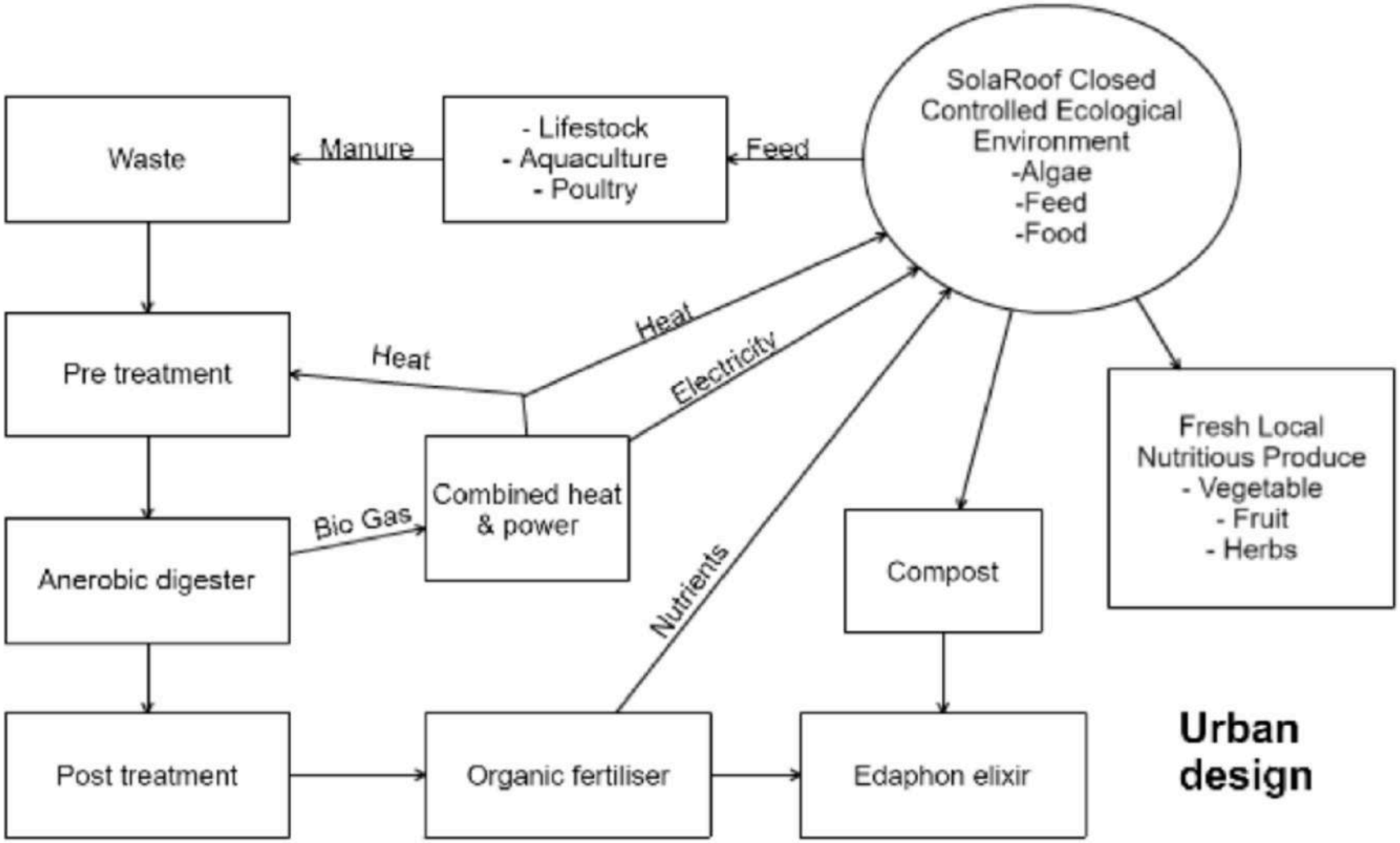
Modular multipurpose greenhouses / flat roofs

Fast to erect
& very low
running cost

Designed for
Venlo conversion

Algae culture can circulate beneath the SolaRoof in a vertical production set-up.
Our solution can also be delivered as pitch roof.

SolaRoof in circular economy set-up



SolaRoof dedicated to algae production

1) Ensure correct temperature for the algae in highly cost-effective SolaRoof buildings through innovative climate control methods that only add a small cost to the CAPEX compared to the Dutch standard glass greenhouses, and is much faster to erect, but is expected to reduce the energy need for heating and cooling with over 80%.

2) We expect that due to the large liquid thermal mass represented by the algae culture, we will be able to run the SolaRoof totally free from open ventilation. Thus, limiting the need for any additional equipment to protect the algae culture from contamination.

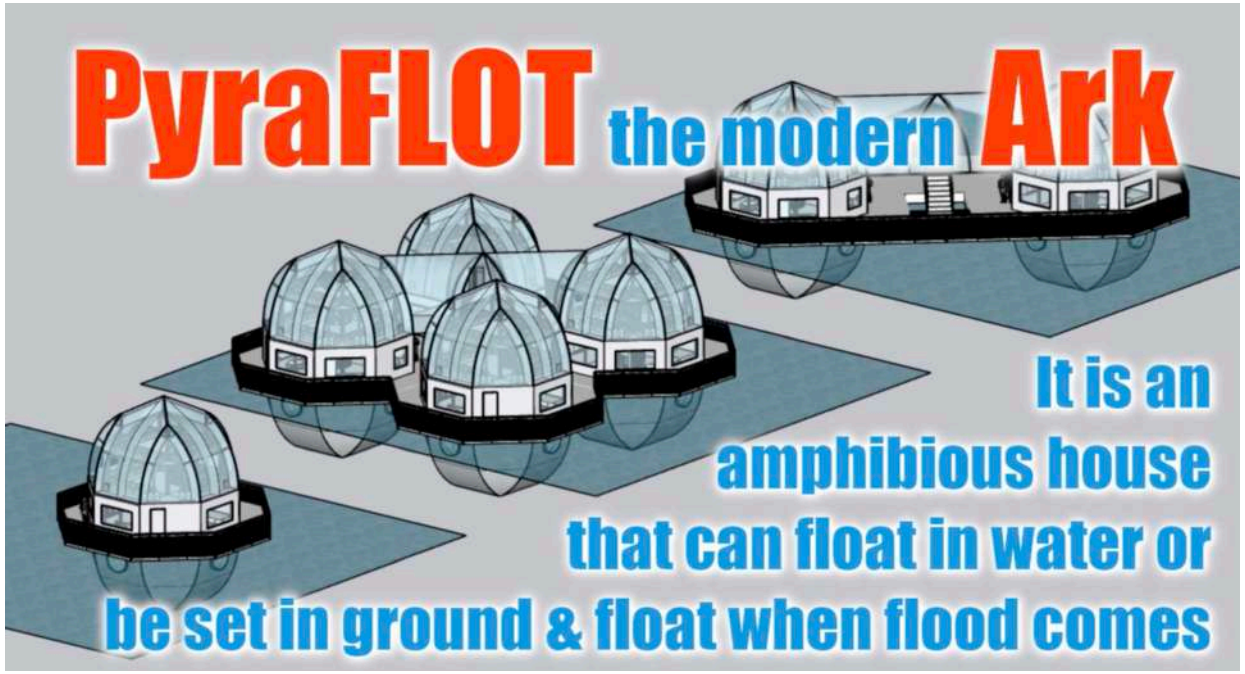
3) High density algae culture. We estimate that we will achieve between 500-1500l of algae culture per m2 floor area (compared to 50-200 per/m3 for other indoor systems), and still be able to secure that the algae gets adequate access to natural light through our own patentable flash exposure methods.

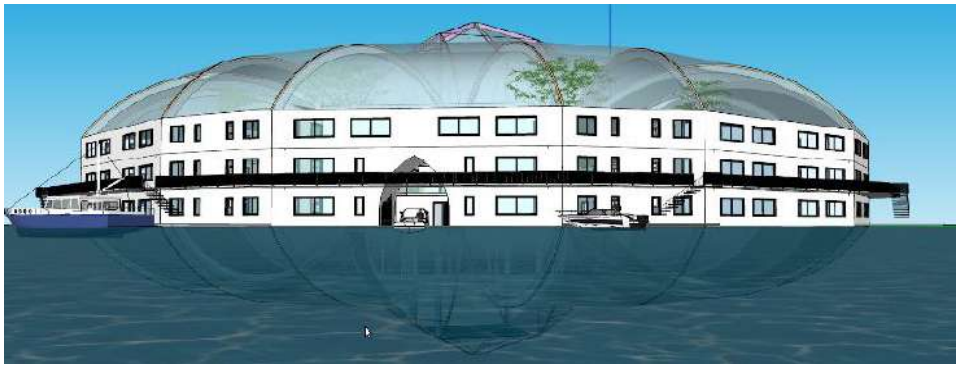
4) High concentration of CO2 both through nano bubbles in the tanks as well as a high concentration of CO2 gas in the atmosphere.

5) Innovative harvesting method.

Algae: Global marked expected to raise from US$21Bn (2021) to US$55Bn (2031)

As it is beneficial for SolaRoof structures to be connected to large liquid thermal mass - floating fits fantastically.
We have plenty of ideas and interest in this already.





Watch inventor Richard Nelson's vision for SolaRoof in this **YouTube**:

https://www.youtube.com/watch?v=4ImOKccwWso

Suntean targets several high-growth markets:

1. Urban farming: $236 bn (2021) - $500 bn (2030)

2. Renewable energy: $1.1 trillion (2020) - $2 trillion (2030) of which $55bn is algae.

3. Climate-controlled greenhouses: $75 bn (2021) - $172 bn (2028)

Our greenhouses cost approx 20% more than average, but reduce energy needs by approx 80%, which typically are over 50% of normal production cost. For algae production, in addition this 50% reduction, we also substantially reduce the need for equipment (E200-400m2).

4. By 2031, the market is expected to reach a value of $9.23 billion, growing at a CAGR of around 12.8%

5. By 2050, it's projected that 143 million people could be displaced due to climate change, with 30 million already displaced annually, requiring more than $20 billion in emergency relief funding.

Suntean has furthered the inventions of Richard Nelson…

… to unlock the potential of SolaRoof for

ecological life support and life supportive living.

Our key team members are:

Anne Helene Wirstad

20 years experience with SolaRoof; Sales & Marketing.

Jørgen Wille

Economist; Building Engineer; Carpenter; Pioneer within energy efficiency in buildings.

Xavier Dequaire

PhD level Solar Energy and Passive House expert; IT developer.

Our potential contributions to help solve the SDGs are broad:

SolaRoof can with multiple benefits be integrated into many types of existing and new build as a **cheap way to achieve both daylight and high insulation** value; both for sustainability and health issues. Is represents an unparalleled way to enable **secure, local and environmentally friendly food production globally** with substantial **reduction in water needs**. **Poverty** alleviation. Will eliminate **hot roof issues and heat island effect of cities**. Suitable for affordable as well as luxury housing (large **sunroofs**, **winter gardens**, atriums, low energy climate control in harsh climates, **humanitarian 'tents'**, **semi-permanent**). SolaRoof offer many ways to help limit migration due to climate change and rise in sea level (**floating structures**, and **greenhouses** with **lowered water needs**). SolaRoof can be used as **cost-effective method for large scale production of algae to energy** (gas, oil or hydrogen), biopharma, nutraceuticals, feed, food, fertilizer, plastic.. SolaRoof buildings and greenhouses can be a significant catalyst for expansive **nature regeneration, greening of deserts and recruiting to the agriculture sector**.

SUNTEAN

..protean buildings for a thriving future

Co-creating global sustainability and and a future that call can celebrate.

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