



ETFE SMART GREENHOUSE

DESIGN & BUILD GUIDE

ADAS HIGHTEX PTE LTD





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ADAS Hightex Pte Ltd

ADAS Hightex Pte Ltd specialises in providing agro-technology services and the design, engineering, and construction of innovation greenhouse infrastructure with the goal: to make farming simple. Our ETFE Smart Greenhouses are integrated with IoT (Internet-of-Things) Systems, to help users achieve their ideal growing conditions. We offer comprehensive solutions tailored to your farming needs, from large scale commercial production to small scale hobbyist growers.

The ADAS® brand is a leading provider of analysis, design, and engineering solutions for specialised structural systems. Our principal products include ETFE Smart Greenhouse, Tensile Membrane, ETFE Skylight, Spaceframe, and many other specialised structures. We comprise of an international team of architects, engineers and computer experts with its principal office in Singapore and four other offices overseas.

Since 1988, we have completed the design and build of over 700 projects from all around the world.

About Us

ADAS® Green aims to set the standard for high quality, all-in-one greenhouse solutions for growers and horticulturalists. In the face of climate change, it is more vital than ever to provide accessible agritech solutions to support the pursuit of food security worldwide. ADAS® Green's integrated greenhouse solutions empower farmers to take the next steps into the smart farming revolution.

Environment study and simulations

Our team of experts are readily available to provide consultation and analysis services to assess the greenhouse functionality. Our preliminary studies take into account of the temperature, ventilation, light, and other environmental conditions to strive for a low-energy greenhouse design. Our indoor environment simulation helps our greenhouses achieve the ideal growing conditions for our clients' projects.

Design and build

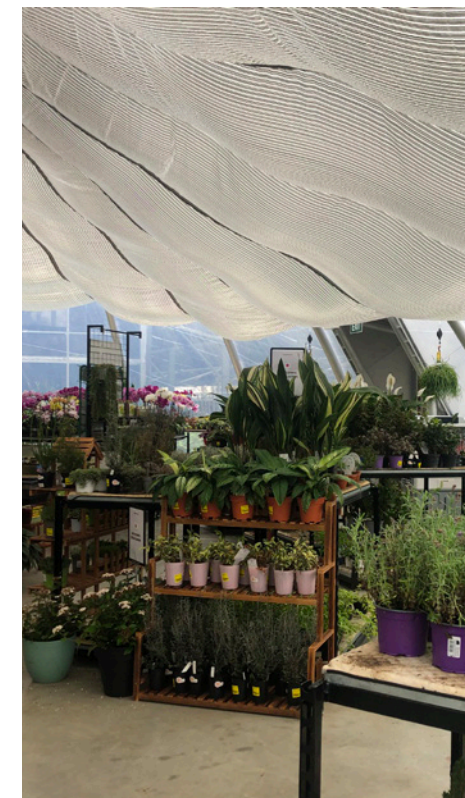
Our ETFE greenhouses provide structural, material and aesthetic quality beyond compare. We aim to deliver a complete solution from value engineering and component integration to installation. We have a deep knowledge in construction and our client-centric approach to design ensures our ETFE greenhouses are able to perform to our clients' expectations.

IoT system integration

ADAS® Green offers end-to-end software and hardware solutions for specialised greenhouse systems. By becoming reactive to external conditions, each greenhouse can maintain optimised growth conditions through customisable climate control. The control system comes with a user-friendly interface to operate the different climate control components.

Farming analytics

With an IoT infrastructure in place for climate control, we are also able to offer cloud-based services to store, view and analyse data collected from the greenhouse. This data provides farmers with the figures needed to make informed farming decisions and improve growing conditions as well as yield.



Get in Touch

Visit our website at:
adasgreen.com



SMART Greenhouse Features



Greenhouses have been improving over the decades to allow for greater technological integration into the environment control and the farming process. SMART greenhouses are becoming more prevalent as means for controlled environment agriculture, providing many additional benefits on top of improving the productivity of the farm.

Data-driven agriculture

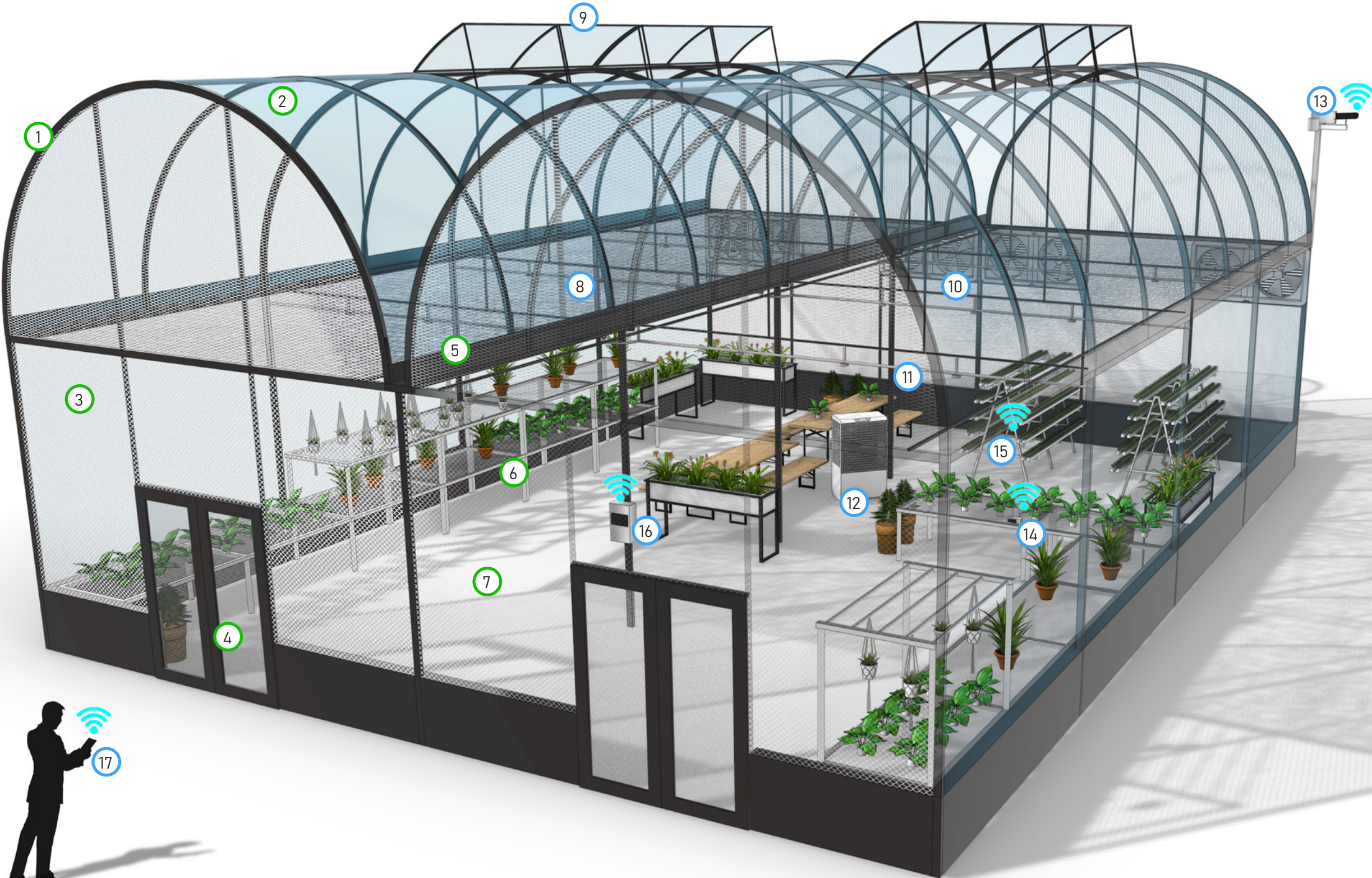
SMART greenhouses can collect environmental and farming data, allowing farmers and researchers to study the growth patterns of crops. Additionally, with real-time feedback of growing conditions, users are equipped to make data-driven decisions with regards to their farm operations.

Flexible growing environment

With climate change leading to more unpredictable weather conditions, SMART greenhouses provide users with more control and flexibility over growing conditions. They can also be used to grow plants in different climate conditions or provide protection should the natural environment turn unfavourable.

Remote operations

SMART greenhouses enable the remote control of the farming operations and growing conditions, reducing manpower requirements of farming. It also provides convenience to the user, allowing them to easily manage more farms and resolve issues without having to be physically present.



Greenhouse Structure

- 1. ADAS® Structural Steel
- 2. ADAS® Greenhouse ETFE
- 3. Insect Netting
- 4. Door
- 5. Gutter & Rainwater Collection
- 6. Greenhouse Racking
- 7. Greenhouse Flooring

Microclimate Control

- 8. Retractable Sunshade
- 9. Openable Vents
- 10. Fans
- 11. Misting System
- 12. Chiller System
- 13. Outdoor Environment Sensor
- 14. Indoor Environment Sensor
- 15. Growth Medium Sensor
- 16. ADAS® Control Unit
- 17. ADAS® Green Web App



PREMIUM



ARCHITECTURAL



PRODUCTION



TENSINET



ROOFTOP

ADAS® Greenhouse Design

ADAS® Green provides various types of greenhouses catered to our clients' needs. We take into careful consideration our clients' growing conditions, budget and aesthetic requirements when designing each greenhouse. Here are our five most popular kinds of greenhouse design solutions:

Premium Greenhouse

For smaller scale projects that require a high level of personalisation, these greenhouses are designed with quality and customisability in mind to meet the needs of our clients.

Architectural Greenhouse

With the flexibility of ETFE film, the design of greenhouses can be free-form, iconic, and creative. This is ideal for displaying agricultural products, either for retail purposes or for growth system showrooms.

Production Greenhouse

Efficiency is the key for the commercial greenhouses. We maximise the potential of space while minimising structures and materials, to produce the best yield possible that is both high quality and abundant.

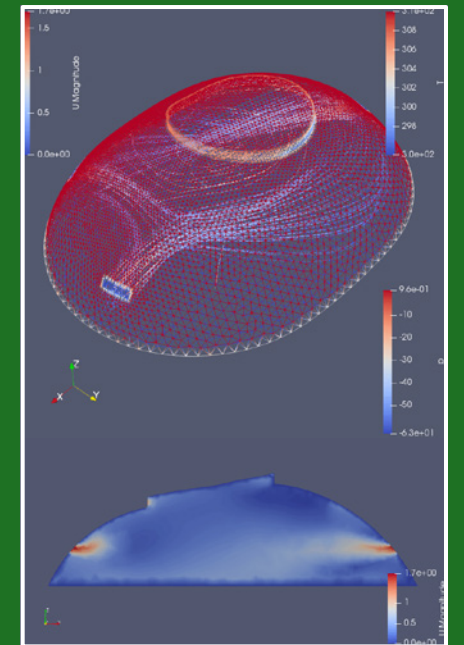
TensiNet Greenhouse

Our cable net structural solutions are lightweight and minimalistic, reducing fabrication and installation costs. Large scale farming systems benefits the most from using this system to protect their crops.

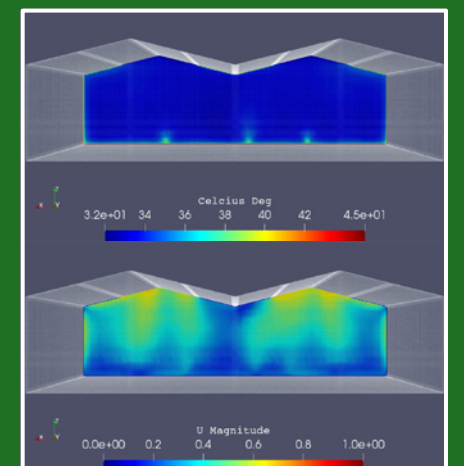
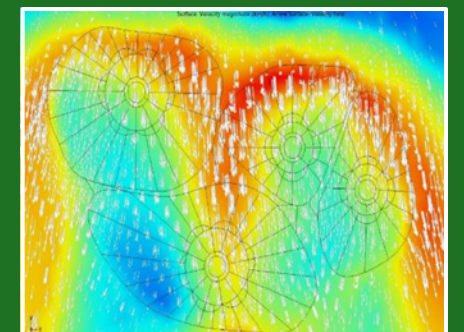
Rooftop Greenhouse

Our rooftop greenhouses help to convert vacant roof spaces into opportunities for urban farming. Lightweight and simple, they are easy to install and remove without causing damage to the surfaces of building rooftops.

ADAS® Greenhouses are only bound by your imagination!



ADAS® Greenhouse Designs are supported by our advanced environment simulations to optimise greenhouse performance. We can determine how to capitalise on natural lighting, shading and ventilation combinations to improve the interior environmental conditions while reducing energy consumption.





What is ETFE?

ETFE or Ethylene Tetrafluoroethylene is a high-quality plastic film material that is extremely durable and resistant to corrosion and heat. The material is transparent, lightweight, and strong, which allows it to be used in place of glass in architectural and agricultural projects. ETFE film is naturally cleaned with rainfall and can also be recycled, making it an environmentally-friendly and sustainable material to use.

Why ETFE?

ETFE has high light transmission properties which makes it ideal for greenhouse roof and walls. Its light weight requires less structural support, reducing construction time and costs. The surface of ETFE film is non-stick, greatly reducing the accumulation of stains and dirt. It is also resistant to UV deterioration and does not turn yellow and brown over time. It can last over 30 years with only minimal maintenance, making it an ideal material for high-quality SMART Greenhouses.


ETFE Film Material



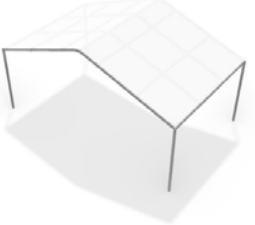
Compared to other materials, ADAS® ETFE Film is the superior choice for its durability, lightweight, and low maintenance as greenhouse cover material. It is a high quality material with long lifespan and excellent durability.

Material	Glass	ADAS® ETFE Film	Polycarbonate	Polyethylene
				
Lifespan	30+ years	30+ years	10-15 years	3-5 years
Self-weight (kg/sqm)	30.0	0.3	3.3	0.3
Steel Weight (kg/sqm)	65.0	20.0	40.0	20.0
Light Transmission	85%	0% - 95% (custom)	65-80%	90%
Flexible	No	Yes	Yes	Yes
Fire Resistance	High	High	Low	Low
UV Degradation	Low	Low	High	High
Maintenance & Cleaning	High	Low	Medium	Low

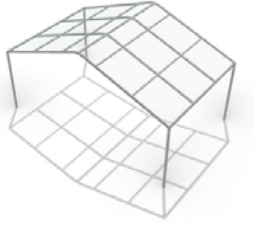
ADAS® ETFE comes with a wide selection of films available to suit your farming needs. The Clear ETFE, Diffuse ETFE, and UV cut ETFE options are the most popular choices among our customers.



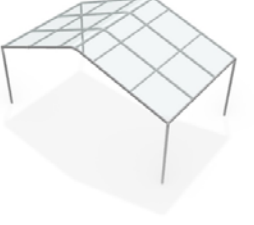
Grey
Cuts up to 99% of light transmission



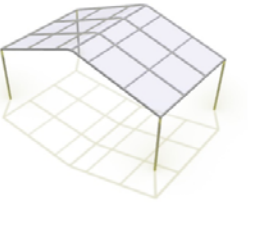
Soft shine
Cuts infrared rays but still transmits visible light



Clear
Full spectrum of solar light transmitted



Diffuse
Soft diffused light while maintaining high transmission



UV cut
Three grades with different grade of UV-cut as required

Most popular for Greenhouses

Clear ETFE offers the best light transmission, of up to 94% of the full spectrum of solar light.

Diffuse ETFE has a unique matte surface which helps to spread light evenly within the greenhouse, reducing harsh shadows and dark corners.

UV cut ETFE has 3 different grades available which cuts 62-92% of UV light, which are required to grow certain species of plants.

Greenhouse Performance

Thermal Performance

High temperature and humidity are a prevalent issue for tropical greenhouses, and can adversely affect crop growth and health if managed poorly. ADAS® Green is dedicated to providing effective climate control solutions to tackle these issues.

Generally, we utilise two design strategies for maintaining temperatures within an ideal range in the greenhouse. The first is an ambient temperature design which focuses on using natural and mechanical ventilation to cool the greenhouse. This is a low-energy solution that helps to circulate air and remove excess heat. If more cooling is required, the sub-ambient temperature design aims to keep cool air in and reduce solar heat gain from the exterior.



Optical Performance

ADAS® ETFE Film has great light transmission properties to ensure that the plants can get sufficient sunlight even during cloudier days. A wide selection of films is available to customise the light conditions that best suit the growing crops, depending on species as well as stage of growth. The film is also able to maintain its high light transmission for well over 20 years as long as it is maintained free of debris and algae.



Energy Performance

We aim to adopt a sustainable approach, relying on passive design and low-energy systems to sustain the greenhouse environmental conditions. We encourage the use of renewable energy and rainwater collection to reduce the energy and resources required for greenhouse operations.



Project Workflow

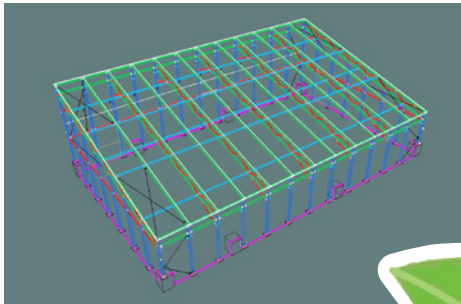
1. Preliminary study

With information from the client, a preliminary study is carried out to assess the requirements of the greenhouse project.



3. Proposal

A design proposal for the ETFE greenhouse, IoT system, or both is presented to the client.

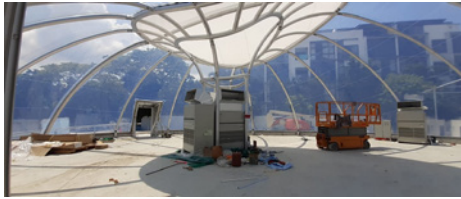


5. Shop drawings

Further engineering and design development will be performed to produce a set of shop drawings to the client's satisfaction.

7. Authority submissions

Upon confirmation of the shop drawings, structural submission drawings will be produced to obtain approval from the relevant authorities such as BCA.

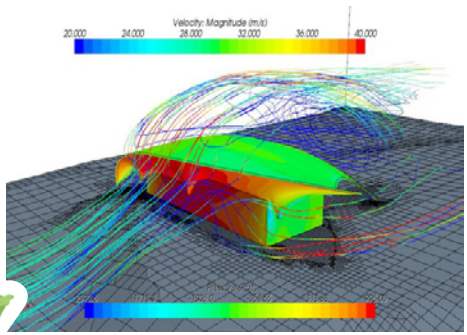


9. Installation and IoT setup

Installation of the structure and IoT system will be overseen by our specialized site staff.

11. Technical support

IoT technical support is available for the first 6 months from project completion.



2. Technical evaluation

Depending on specific requirements, additional analyses may be needed to evaluate the feasibility of a given design.

4. Confirmation

Upon confirmation, our team will be on board the project until completion.



6. IoT prototyping

The project's IoT architecture will be developed at this stage to incorporate the smart components of the greenhouse.

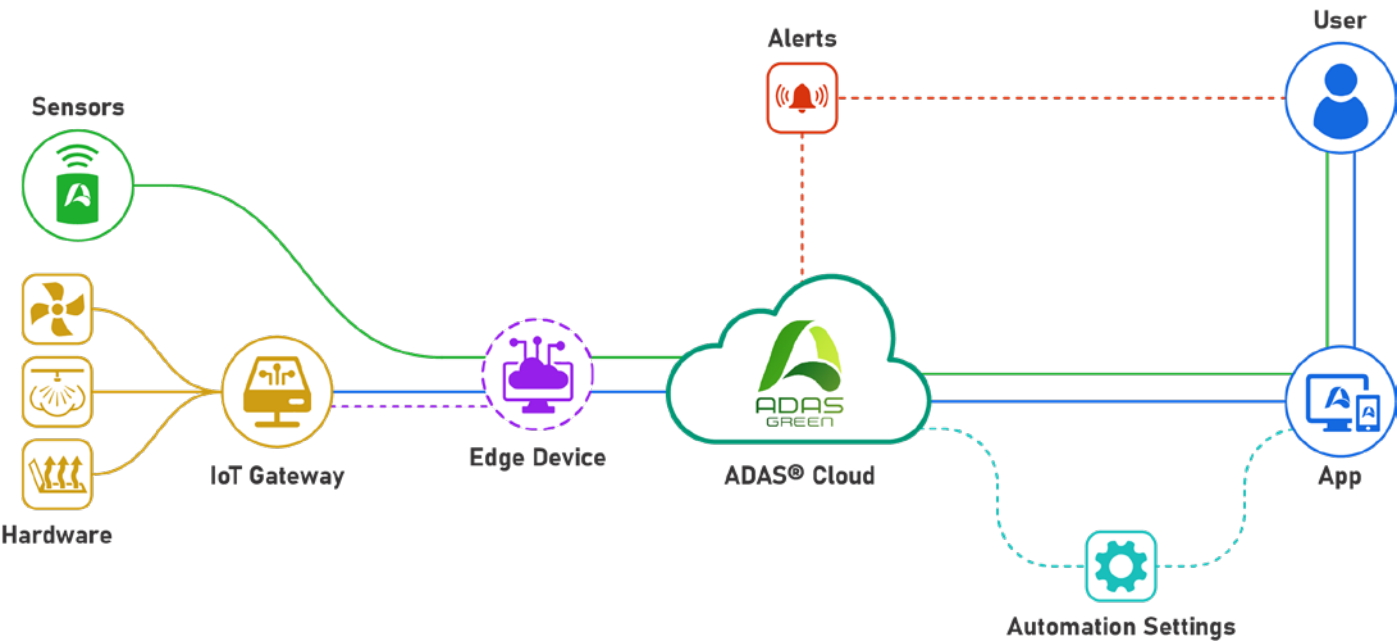
8. Fabrication and software engineering

The greenhouse structure and ETFE film will be fabricated while our software engineers configure the control panel and dashboard with the necessary components.

10. Project completion

Handover process of the project after passing the client's inspection and User Acceptance Test (UAT).

ADAS® Green provides integrated IoT solutions for our greenhouse products and services, from environment sensors to fully automated climate control capabilities. We design customised IoT solutions to best fit the requirements of our clients’ projects.



Our IoT system is developed around the ADAS® Cloud, connecting the external, internal, and growth medium sensors to the user through the ADAS® Green App, allowing them to monitor the status of the greenhouse in real time. An IoT gateway can be provided to connect all the hardware to the cloud, allowing them to be controlled remotely. The user can receive alerts through the app or via messaging and email from the greenhouse about environment changes and updates. Pre-programmed settings can be implemented so that the climate control system can automatically respond to the environmental changes. An edge device can also be included to allow the system to function even when offline.

ADAS® IoT Features	Starter	Essential	Professional	Customised
No. of Devices	1	5	100	100+
Environmental Data Collection	✓	✓	✓	✓
Cloud Data Retention		1 years	5 years	unlimited
Live Alerts		✓	✓	✓
Real-time Data Dashboard Display		✓	✓	✓
Plant Growth Monitoring		✓	✓	✓
Greenhouse Remote Control		✓	✓	✓
Growth Cycle Analytics			✓	✓
Time-based Events and Scheduling			✓	✓
Automated Greenhouse Operations			✓	✓
Edge Device			✓	✓
Growth Target Driven Automation				✓
Other Customised Features				✓

Sensor Suite

Having the right environment conditions are vital to the growth and health of plants in the greenhouse. The ADAS® Green Sensor Suite allows a wide range of environmental parameters to be monitored, providing the user with more information to help them grow. They are easy to install and use, and can even send alerts when abnormal conditions are detected in the greenhouse.



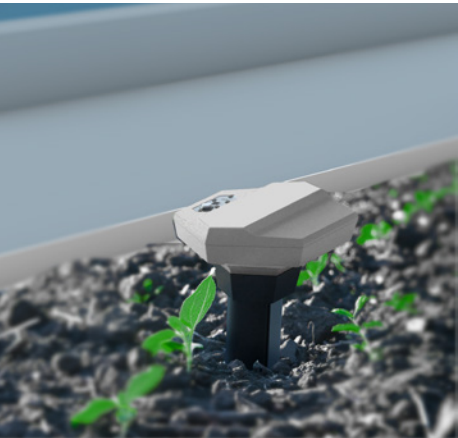
External Sensors

- Temperature
- Light (Lux)
- Relative Humidity
- Air Pressure
- Windspeed
- Rain



Internal Sensors

- Temperature
- Light (Lux)
- Relative Humidity
- Air Quality (VOC / CO2)
- UV & IR Measurements
- Time-lapse Imagery



Growth Medium Sensors

- Temperature
- Soil Moisture
- pH
- Nutrients

Controllable Environment

The IoT gateway can be connected to a variety of greenhouse hardware, allowing them to be controlled. The user can either manually control these hardware in the greenhouse, or via the ADAS® Green web application. With ideal parameters set by the user, automation settings can be programmed so that the climate control hardware can immediately respond to fluctuations in greenhouse environmental conditions.

The design and layout of the climate control hardware can be customised to fit the needs of our client’s projects. We always support our design with simulation and studies to achieve a efficient and energy-saving layout.



Hardware & Accessories

Insect Netting

Insect netting walls are a popular way to allow for natural ventilation while also protecting your growing plants from insects and other pests. They are flexible and easy to install for ambient temperature greenhouses.



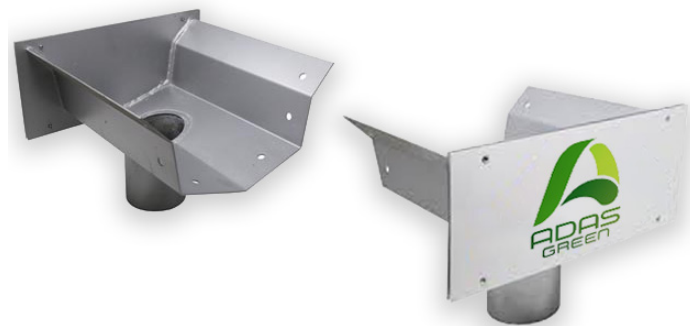
Door

For production greenhouses, double-layer doors are recommended to reduce contamination from the external elements. Smaller or simpler greenhouses may opt for single-layer swing or sliding doors.



Gutter & Rainwater Collection

Gutter and rainwater downpipe systems are necessary for larger greenhouses to deal with heavy rainfall. The rainwater can also be collected to be reused in the greenhouse.



Greenhouse Racking

Benches, shelves, and racking can help to improve the space utilisation within greenhouses. ADAS® Green provides integrated racking solutions to help our clients optimise their space usage for growing plants.



Greenhouse Flooring

Concrete is the most durable flooring material for greenhouses as it allows for easy drainage and prevents the spread of mould and diseases. Pavers, porous mats, and gravel are other flooring options which provide drainage for greenhouses while requiring less intensive groundwork.



Sunshading

Sunshades can be installed both internally and externally on the greenhouse to protect the plants from excessive solar exposure. A retractable sunshade system is a great way to manage the interior environment conditions, adjusted accordingly to the weather outside.



Roof Vent

Roof vents and openings help to release heat trapped within the greenhouse. They can be operable to open when temperatures are high, and be closed during heavy rain to prevent rainwater ingress.



Fans

Fans play an important role in ventilating the greenhouse, especially for large-sized projects. Intake and exhaust fans provide adequate air exchanges, ensuring that crops receive sufficient carbon dioxide while also removing excess heat. Circulation fans improve the internal airflow, allowing for more even temperature and humidity within the greenhouse and preventing stale air from being trapped. The fans can be integrated with cooling pads and misting systems to further reduce temperatures within the greenhouse.



Chiller System

Chillers and air-conditioning systems provide finer control of the environment conditions within the greenhouse. They are suitable for maintaining sub-ambient temperatures and humidity levels, depending on the type of plants being grown.



Your Greenhouse:

Hi, I am looking for...

☐ Premium

☐ Architectural

☐ Production

☐ TensiNet

☐ Rooftop

... type Greenhouse

Please feel free to let us know more details!

Company Name:

Greenhouse Area: m²

Address:

What you will also need:

- Greenhouse cover material

☐ Full ETFE Greenhouse ☐ ETFE with Insect Netting (recommended) ☐ Insect Netting only
- Door

☐ Swing Door ☐ Sliding Door ☐ Double-layer Doors ☐ No Doors (open greenhouse)
- Gutter & Rainwater Downpipe

☐ Gutter ☐ Rainwater Downpipe ☐ Rainwater Collection System
- Flooring

☐ Concrete ☐ Pavers ☐ Steel Grating ☐ Gravel
- Sunshade

☐ External Sunshade ☐ Internal Sunshade ☐ Motorised Retractable System
- Roof Vents

☐ Fixed Roof Vents ☐ Operable Roof Vents
- Fans

☐ Exhaust Fans ☐ Intake Fans ☐ Circulation Fans ☐ Cooling Pads ☐ Misting
- Chiller System

☐ Portable Chiller ☐ Air-conditioner ☐ Concealed Air-conditioner
- ADAS® IoT System

☐ Starter (sensor only) ☐ Essentials (climate control) ☐ Professional (automation)

☐ Customised IoT Solutions (please contact us for more information)

Your Name:

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Email:

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ETFE SMART GREENHOUSE

DESIGN & BUILD | ENVIRONMENT STUDY | IOT INTEGRATION | FARMING ANALYTICS





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