Organic Power – Biomethane Ltd

Composite Cryogenic Tanks

for the

Transport and the Storage of LNG

A presentation by Christopher Maltin

During the Greenshipping Innovation Workshop

"Fibreglass Reinforced Plastics vs Stainless Steel in Vessel and Tank Construction"

at

Hajé Hotel, Schans 65, 8441 AC Heerenveen, The Netherlands

on

Thursday 17th November 2016

Introduction

First of all I would like to say a big thank you to Mariko, particularly Leo van der Burg for putting together this timely Workshop and to Joshua Morshead for inviting me to give this presentation

Background to Biomethane Ltd

Biomethane Ltd is a small UK company based in Somerset, a county in the south West of England

We are self financed and completely independent of any multi-national group or any government departments

Background to Biomethane Ltd

Location of offices and workshops

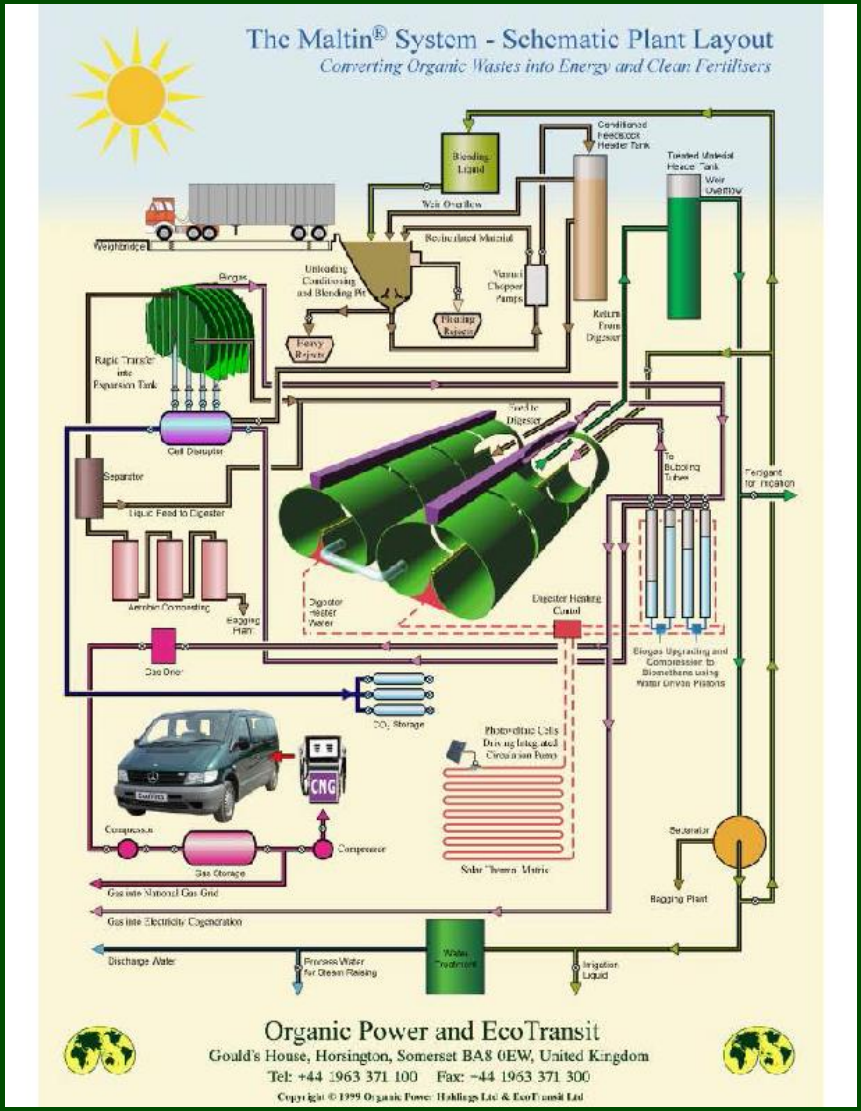
Background to Biomethane Ltd

Aerial photograph of Organic Power headquarters

Background to Biomethane Ltd

Aerial photograph of Organic Power headquarters

Organic Power's Technology



LNG: Collection, Transportation and Storage

The theme of this presentation is to show the designs we are developing and the direction we are following to improve the present methods of collecting, transporting, and storing LNG at the point of use

The Overall Transportation Concept

This slide triggers the GoByGas video from YouTube

Availability of Gas Powered Vehicles

Nearly all the major vehicle manufactures now produce gas vehicles and these could all be refuelled by this system

Present UK Distribution point for LNG

Isle of Grain: National Grid LNG

The Isle of Grain is the only LNG road tanker loading facility presently available in the UK

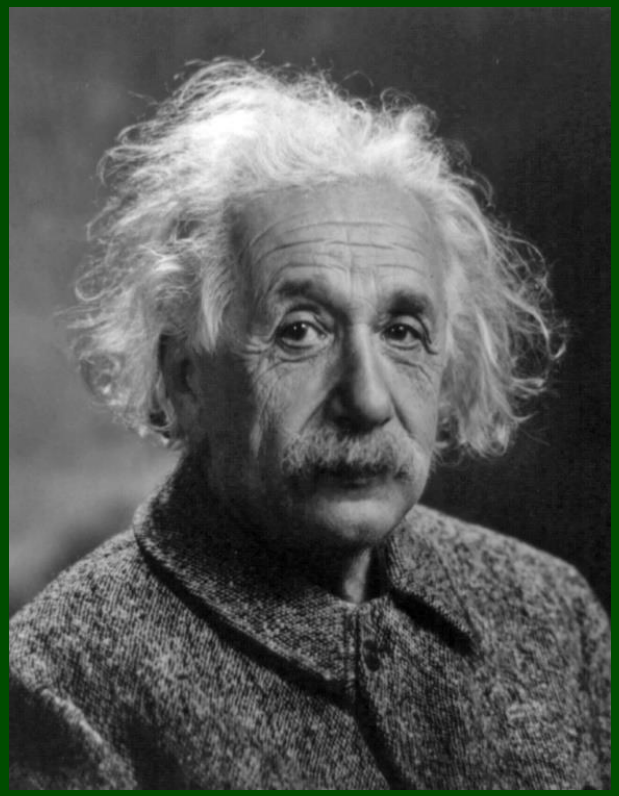
Conventional LNG Transport Method

So we have to do some thinking

The Thinking

"We cannot solve our problems with the same thinking that created them"

Albert Einstein



Transporting the LNG by road

- This is the present method using a cryogenic road tanker
- The proposed method uses an exchangeable composite tank on the flatbed of a small van.
- By shipping LNG in smaller tanks, directly to container ports, the necessary road mileage is reduced

Standard 7.5 tonne Iveco flatbed van running on CNG

UK Container Ports

Typical low cost transport vehicle

LNG “Exchange Tank” Criteria

- In order to utilise this method of distribution, the development of a lightweight tank was critical
- As well as the obvious size constraints, there were a number of issues with existing LNG tanks that we wanted to improve
- Existing stainless steel tanks were too heavy to be transported by Light Goods Vehicles
- Existing designs were cylindrical (to cope with the pressure) and were therefore an inefficient use of space
- Unique engineering solutions were required for the securing and transfer of these new lightweight tanks

LNG “Exchange Tank” Design

- Our commercial design now uses a honeycomb structure formed by braiding a mixture of polyetheretherketone (PEEK) and carbon fibres

- Peek is a thermoplastic semi-crystalline organic polymer which is extremely stable at extreme temperatures and we have now perfected our blending of this with long chain carbon fibres

LNG "Exchange Tank" Design

- Our unique combination of these materials, our honeycomb based design and our novel application of insulation materials has resulted in the design on an LNG tank which:
  - can be designed to fit almost any shape and be made to any size
  - carries the maximum volume of LNG in the space available
  - has a minimum tank weight for a given volume of LNG
  - maximising the insulation effectiveness without a vacuum
  - has negligible internal surge of liquid during transportation
  - is cheaper to produce than are conventional stainless tanks

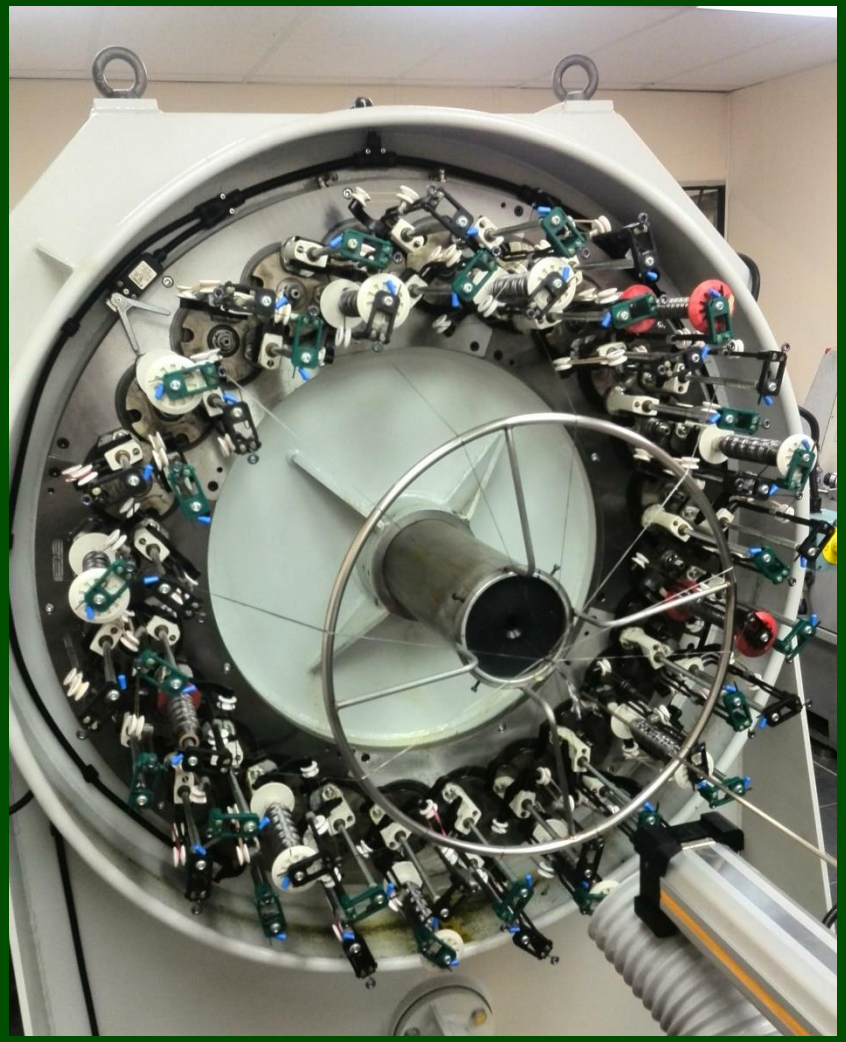
LNG “Exchange Tank” Design

- Additionally we have also developed:
  - an innovative solution to secure the lightweight tanks whilst being shipped, transported by road, and stored
  - A transport method for the tank using lightweight vehicles
  - A method of transferring the LNG tanks from transport to point of use without the requirement for any lifting equipment

LNG “Exchange Tank” Design

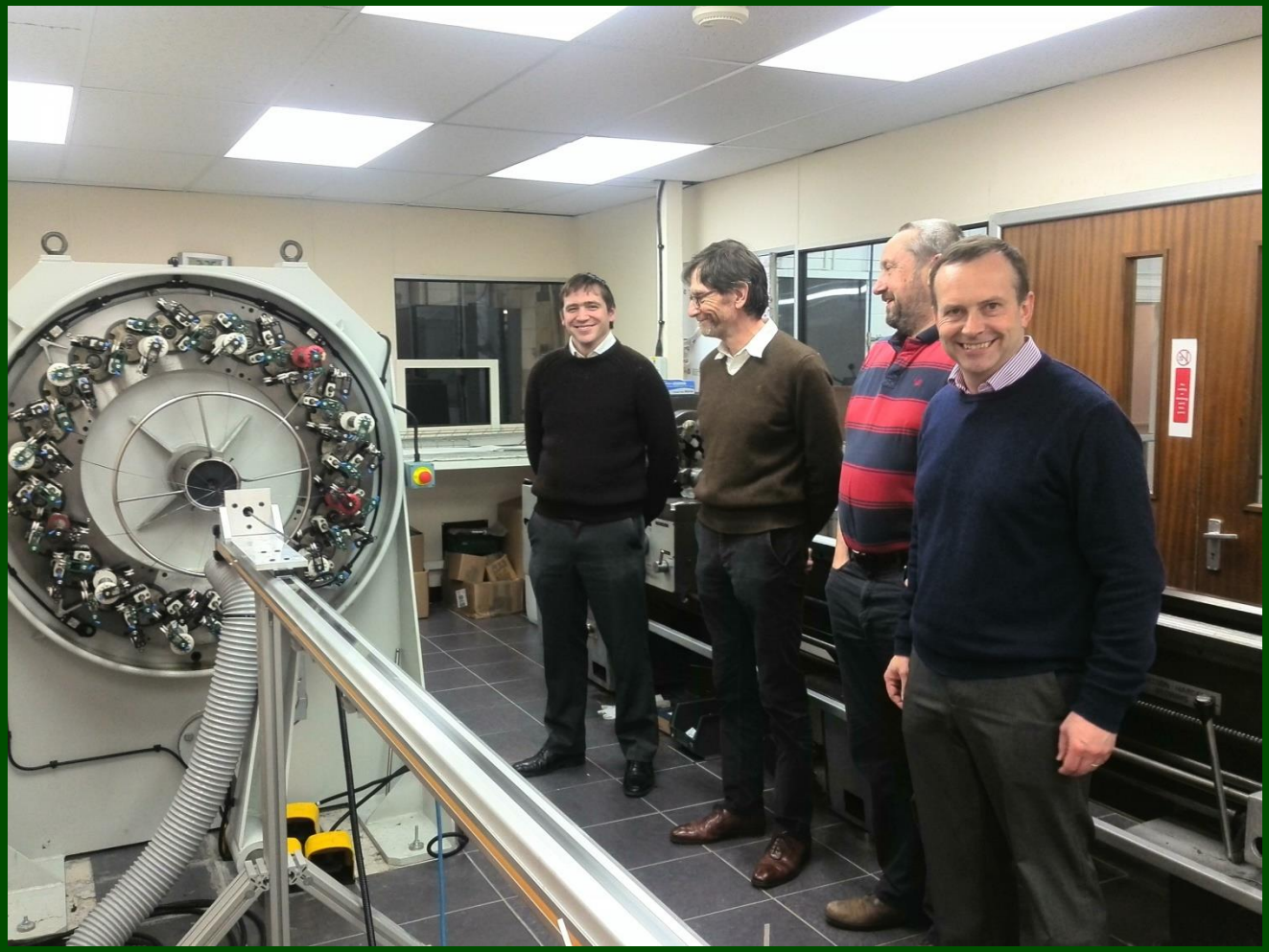
- Our design, evaluation and testing phase is almost complete and we are presently looking for collaboration and funding to take this design concept into certified commercial production

Composite Braiding

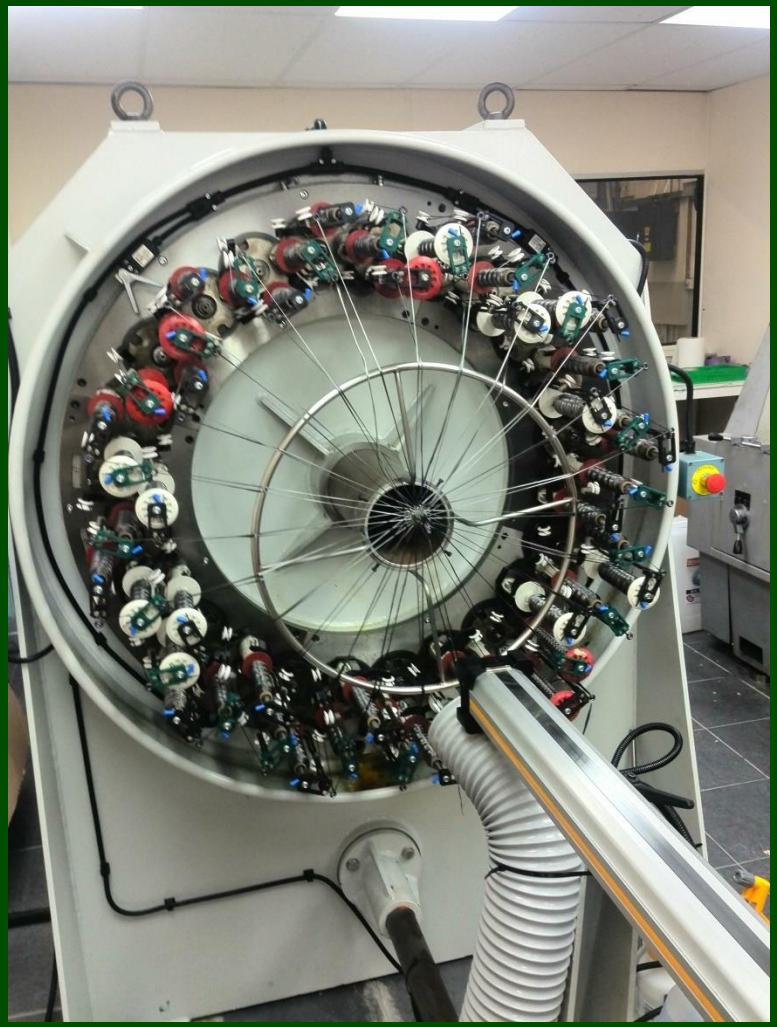


(This slide triggers the video)

The Braiding Development Team



Composite Braiding



Composite Braiding

Lightweight Composite Tank

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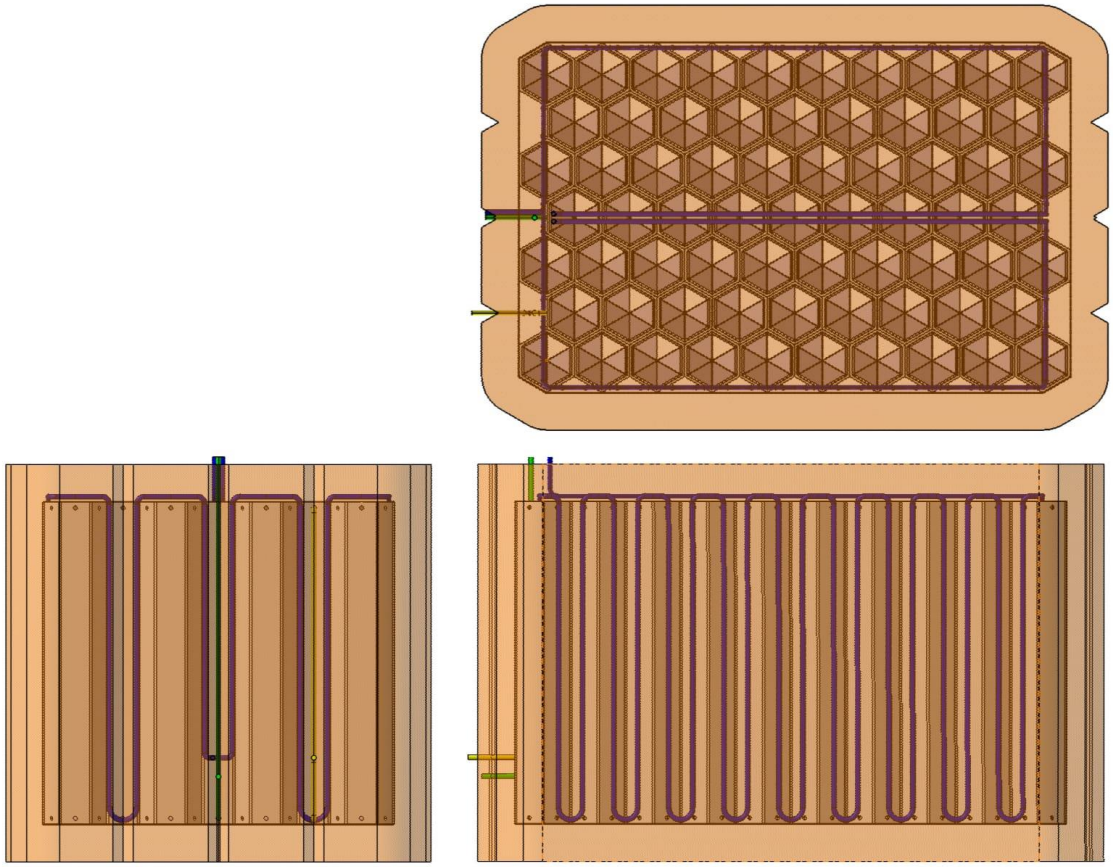

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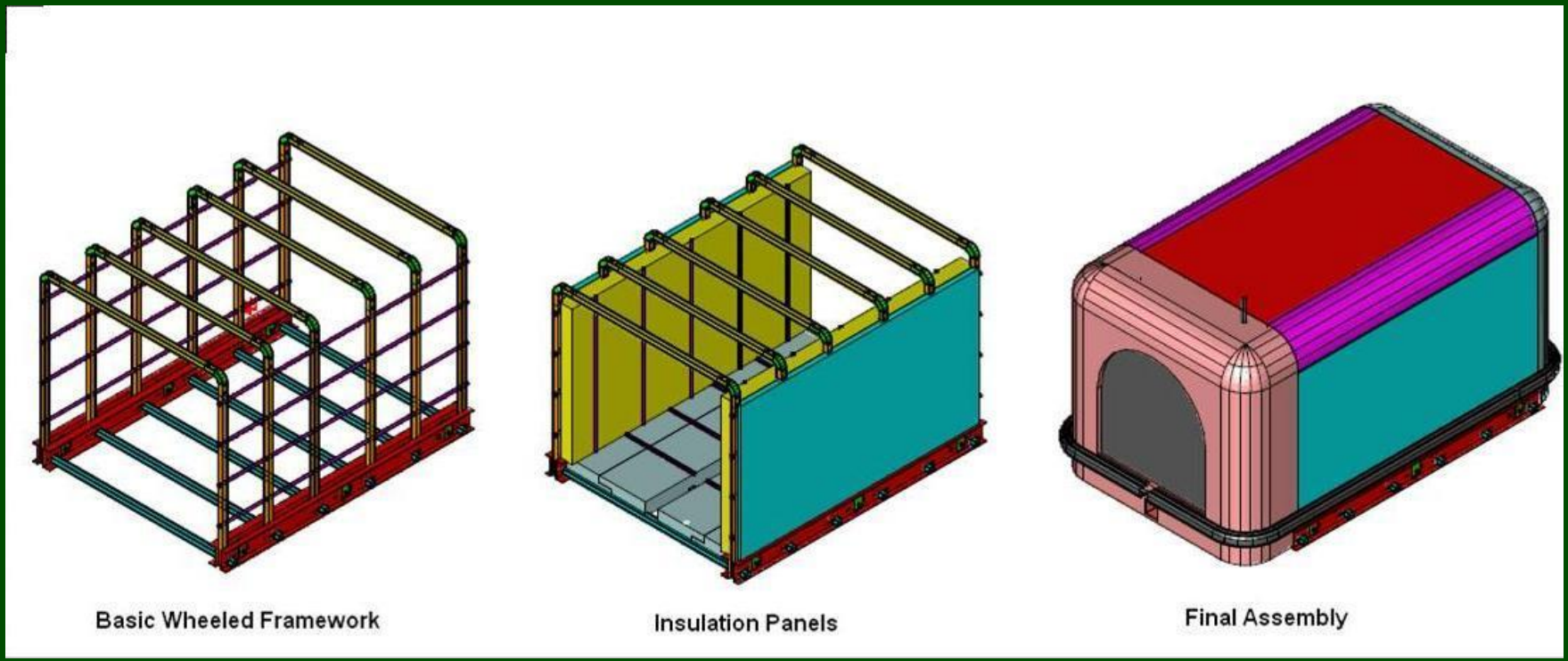
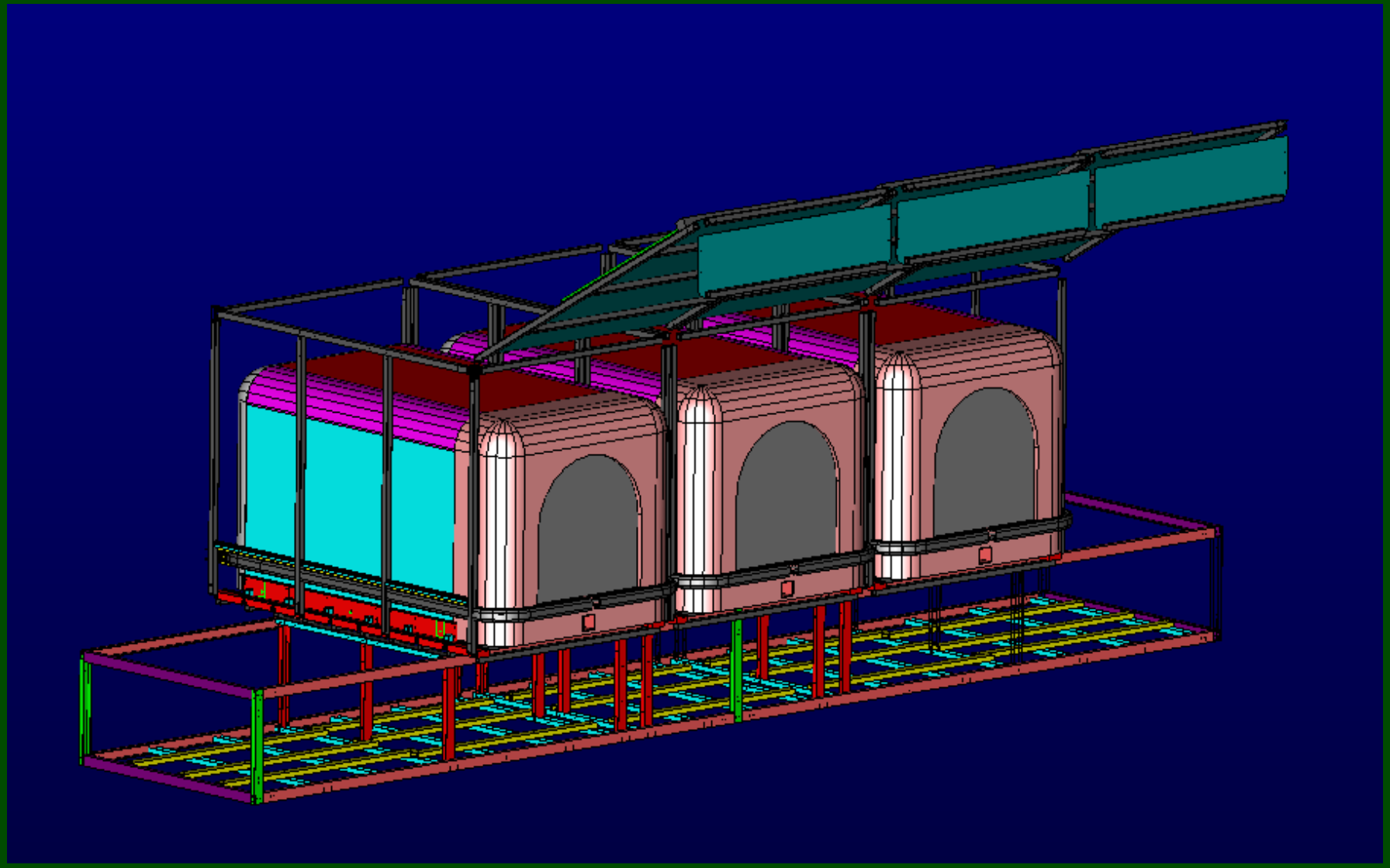
Construction of Tank Protection



Use in a Gas Vehicle Refuelling Station



THANK YOU

ORGANIC POWER / BIOMETHANE LTD

Anaerobically Digesting Organic Wastes

for a Cleaner World

producing

Organic Fertilisers

with

Biomethane as a Vehicle Fuel

Collected, Transported and Stored as LNG in composite tanks

Naturally