



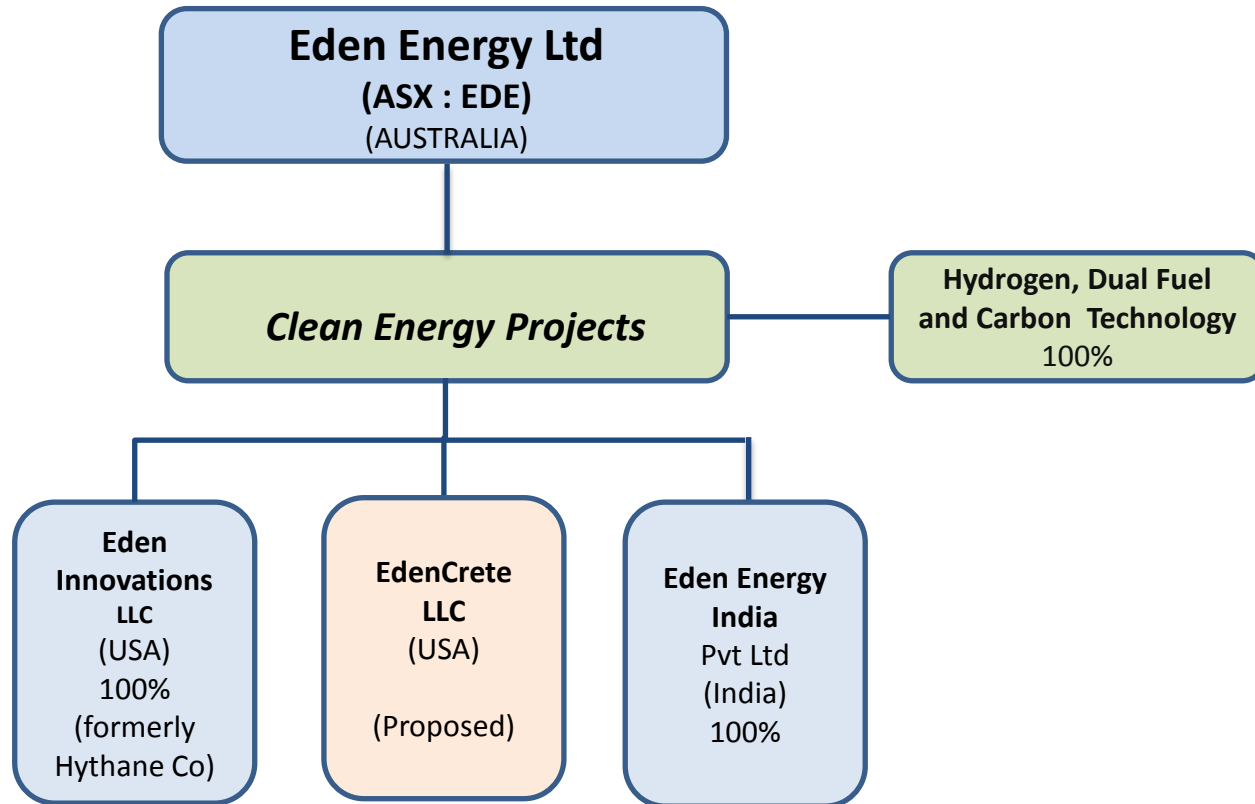
# Revolutionising Concrete

## Carbon Nanotube Enriched Concrete

**Greg Solomon**  
Chairman  
May 2015



# Proposed Corporate Structure



**EdenCrete LLC is proposed to be the US production and marketing company**

# Carbon Nanotube Project



## Eden Developed Pyrolysis Process-CNT/CNF from Natural Gas (Eden 100%)

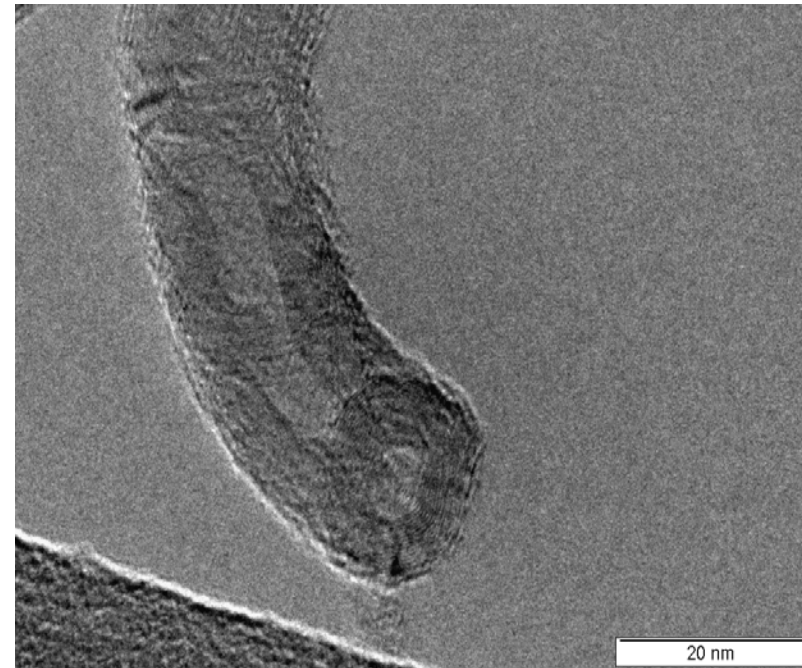


Produces only CNT + H<sub>2</sub> - no CO<sub>2</sub>

- **Multi-walled carbon nanotubes:**

- Tensile strength - 200-300x steel
- Approx. 17% the weight of steel
- High electrical/thermal conductivity
- Bulk uses –  
concrete/plastics/polymers

- **Patents in 8 countries**



TEM image of Edén's MWCNT

# Eden's CNT/CNF Production Capacity



- **Eden's Pilot Commercial Scale Reactors, Denver**
- **Scalable, modular reactors**
- **Efficient catalyst production**
- **High quality/low cost CNT/CNF**

# CNT in Concrete



- **Significant global research conducted over past 5-8 years**
- **Eden Innovations (formerly Hythane Company) (Denver)**
  - Testing and developing for 4 years
- **Monash University (Melbourne) - Collaboration**
  - Ongoing collaboration since 2011
- **Civil Contractors Federation Environment Award** – Australia 2014
- **International Concrete Companies' Interest**
  - Independent US and Australian trials completed

# CNT in Fresh Cement Paste



ZEISS CARL ZEISS SMT	Field Of View 1.50 $\mu\text{m}$	200.00 nm	Dwell Time 3.0 $\mu\text{s}$	Date: 2/16/2012 Time: 3:10 PM
	Working Dist 11.9 mm	Acceleration V 29.8 kV	Mag (4x5 Polaroid) 76,200.00 X	Blanker Current 0.5 pA

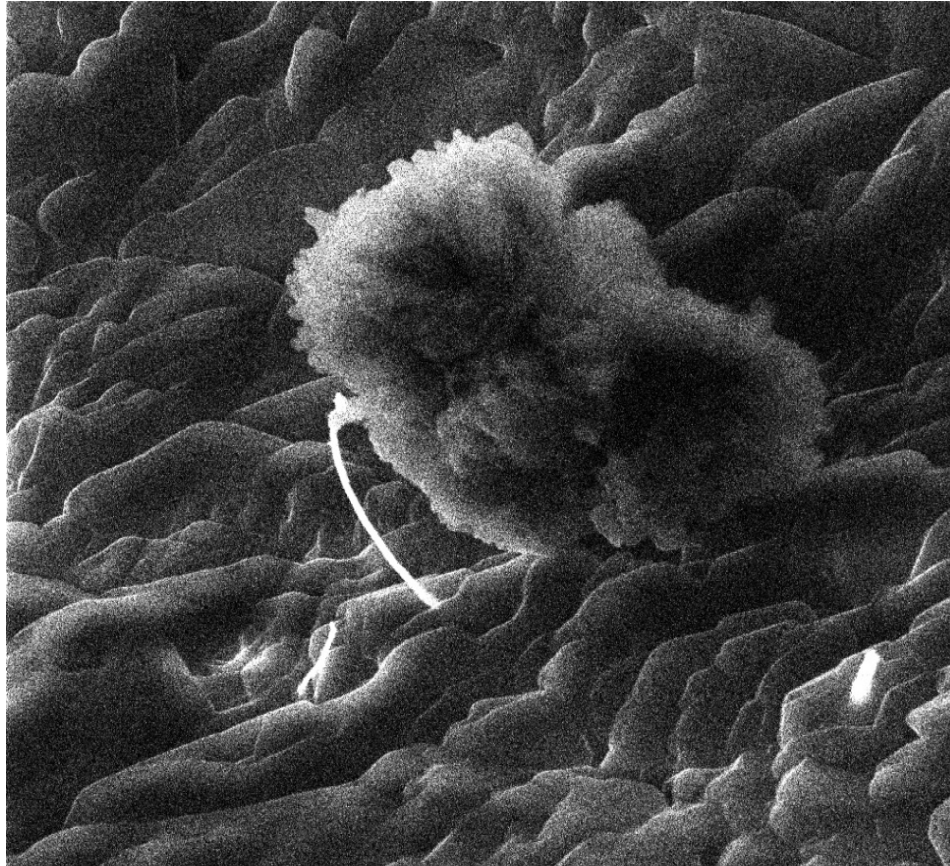
**Build-up of dense, hydrated cement on surface of CNT (top right)**

- **CNT provide:**
  - nucleation points for cement hydration
  - nano-scale fibre re-enforcement.
- **CNT facilitate denser, stronger cement**
- **Other larger-scale fibres provide only nano-scale fibre reinforcement.**

**Monash University Helium Ion Microscope Image**



# CNT in Fractured Hardened Cement Paste



**CNT bonded in hardened cement paste after fracturing**

Ends of CNTs are well-bonded within cement gel and provide anchorage

ZEISS CARL ZEISS SMT	Field Of View 3.50 um	500.00 nm	Dwell Time 10.0 us	Date: 2/20/2012 Time: 3:57 PM
	Working Dist 11.1 mm	Acceleration V 29.8 kV	Mag (4x5 Polaroid) 32,161.91 X	Blanker Current 0.4 pA

**Monash University Helium Ion Microscope Image**

## Benefits – denser, stronger, tougher cement

- **Reduced building costs**
- **Reduced maintenance costs**
- **Less concrete / less steel** re-enforcing required
- **Greater strength-** compressive and flexural/tensile
- **Reduced corrosion-** denser, less permeable cement
- **Liquid surfactant** added during batching process



## US and Australian Trials successfully completed

- **28/56 Day Results from US and Australian Trials**
  - **< 39% increase in compressive strength of concrete**
  - **< 48% increase in tensile strength of concrete**
  - **< 55% decrease in permeability of concrete**

- **Global Applications**
  - **Increased Abrasion Resistance**
    - road and bridge surfaces, pavements , floors
  - **Increased Compressive and Tensile Strength**
    - high rise buildings, bridges , retaining walls
  - **Lower Permeability**
    - dams, spillways , sewer /water pipelines
    - roads, runways etc subject to heavy snowfall and salt
    - coastal and marine applications

# Concrete Market



- **Global concrete/ cement market- US\$450 billion/year**
  - **Approx. 1 tonne of concrete** produced annually for every person
  - **Cement production creates 5% of annual global GHG emissions**
  - **CNT concrete could reduce cement requirements by >15-30%**
- **USA Infrastructure- initial target market**
  - **Total US market ≈700 million tonnes/year** of concrete
  - **≈ 89,000 kms of concrete** paved roads and bridges
  - **≈ US\$40 billion annual** infrastructure maintenance cost

# US Marketing Plans



- **First stage 1,000 tonne CNT production plant**
  - Sufficient for < 1% of US concrete market
  - Initial planning and discussions underway
  - Primary Target Market- Infrastructure Projects
  
- **Future planned expansion- 10,000 tonnes pa**

# Immediate Action Plan



- **US EPA Approval for full scale production and sales**
  - Application prepared, pre-approval permits sale of < 100 tonnes of CNT
- **Colorado Dept of Transport Approval- Target 12 months**
  - Require 4-5 commercial projects for pre-approval list- target 1-2 months- requires several commercial projects
- **Design and cost scaled-up plant-** Process underway
- **Select location for US plant and secure site** –Process underway
- **Secure suitable funding-** Discussions underway in US

# First US Commercial Project



May 2015





**ASX Code: EDE**

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