Solar Innovation in High Value PV Chain

Conserving Now, Preserving Future

Rahul Budhwar, CEO, Flisom AG
Is there an Issue?

Source: The Wump World by Bill Peet
The Issue

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U.S. greenhouse gas emissions by gas, 2015¹

Total = 6,587 million metric tons of carbon dioxide equivalent (CO2e)

- Fossil fuel combustion carbon dioxide: 77%
- Methane: 10%
- Other carbon dioxide: 5%
- High-GWP gases: 3%
- Nitrous oxide: 5%


¹Note: CO2e based on 100-year global warming potential.

Global Greenhouse Gas Emissions by Economic Sector

- Agriculture, Forestry and Other Land Use: 24%
- Transportation: 14%
- Industry: 21%
- Buildings: 6%
- Electricity and Heat Production: 25%
- Other Energy: 10%

Source: https://www.epa.gov/sites/production/files/2016-05/global_emissions_sector_2015.png
# The Issue

**Buildings**
- Utility scale, Conventional Rooftops
- Multiple GWs

**Transportation**
- Light roofs, Facades, Curved Surfaces
- Multiple GWs

**Special applications**
- Silicon & other Glass based Technologies
- Multiple GWs
- 100s of MWs
Vision

Conserving Now, Preserving Future
Enable solar energy to be used in ways not possible before
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Revolutionising Adoption of Solar Energy in 3 Industries

Buildings

Transportation

Special applications
# Uniquely positioned in a Massive Market

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Transportation</th>
<th>Special applications</th>
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<tbody>
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Flisom
Flexible Solar Modules

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About the Company

**STRONG & COMMITTED TEAM**

- 250+ years of combined R&D & manufacturing expertise
- Team of over 65 highly qualified experts

**WORLD LEADING & DISRUPTIVE TECHNOLOGY**

- 20.4% world record efficiency on plastic substrate together with Empa
- Industrial production line in Zürich - Swiss Quality
- Protected by more than 45 patents and trade secrets

**RESEARCH EXCELLENCE**

- Strong R&D partnership with EMPA
- Spin-off from Swiss Federal Institute of Technology ETH Zürich – Ranked #9 globally\(^1\)
- Operating R&D line at EMPA campus

\(^1\)Times Higher Education World Rankings 2016

**STRONG SUPPORT BY PARTNERS & INVESTORS**

- Winner of several tech awards, recently finalist of the Swiss Technology Award 2016
- Backed by $100 Bn+ Tata group and Swiss investors
- Involved in several leading European R&D projects
Technology & Products

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Rethinking the Value Chain

FLISOM

One Factory
Energy Efficient
Fewer Materials
Better Quality
Control

Roll in

Module out

SILICON

Disaggregated
More Energy
Consumption
Less control

Silicon Crystal Growth  Ingot  Wafering  Cell Production  Module Production
The Core Technology

CIGS* machine enabling low temperature semi-conductor deposition on ultra thin plastic films

Laser machine enabling solar cells to be created on the plastic film itself

Unique Equipsments

Flexible Product Design

Ability to customise product design (dimensions, thickness, materials)

Unique Processing

Unique recipes delivering manufacturing volumes, efficiencies and yields

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* Copper Indium Gallium Selenide
World Record Cell Efficiency

- Copper Indium Gallium Selenide (CIGS)
  - Multicrystalline Si: 20.4%
  - Empa CIGS low-tem. process (<500°C) on flexible substrate: 16%
  - CIGS high-tem. process (>600°C) on glass: 20.4%
  - Empa mini-module (coll. with Flisom): 16.9%
  - ZSW: 21.7%
  - Tiina: 0.8%
How are Flisom’s Products Different?

1. Upto 98% Lighter
2. Upto 98% Thinner
3. Fully Rollable
4. Beautiful Black
5. Customisable Technology Platform
Product Portfolio

<table>
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<tr>
<td>eMetal</td>
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<td>eFlex</td>
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Flisom’s product portfolio is a platform for enabling applications in different market segments.
Products in Action

Buildings

Façade in Zurich, Switzerland

Transportation

Airship in US

Special applications

Glass Tubes in Germany
Products in Action - Upcoming

- **Buildings**
- **Transportation**
- **Special applications**
The Challenge & Hope

Conserving Now, Preserving Future
The Challenge

1. Years of R&D
2. Significant Capex
3. Product Development Cycles
4. Forward Thinking