**Adsorption Cooling for India’s Cold Chain**

**Creating Useful Cold with Waste Heat**

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**Problem:**

**Agricultural Sector Production:**  
81 billion kg fruits & 162 billion kg veg.²  

**GDP:**  
17% of India, 350 billion dollars²  

**Annual Waste:**  
40-50% F&V¹ and 20-30% fish¹  

**Why?:**  
Lack of Cold Chain due to Poor Electricity Supply!  

**Cold Chain Market size**  
$2.0B (2009), $4.7B (2013), $12.8B (2017)¹  

**Capacity:**  
<11% of production of perishables

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**Proposed Solution:**

Off-Grid Adsorption Cooling Systems

- Adsorption Heat pumps may be powered by waste heat from an engine or generator.
- Cogeneration of heat with electricity greatly improves the efficiency of energy utilization of a fuel.
- Novel high surface area adsorbents called Metal-Organic Frameworks allow tuning of pressure of refrigerant adsorption, and adsorb much more refrigerant.
- Miniaturization of adsorption systems with improved sorbents will allow integration into mobile refrigerated trucks, as well as village-scale crop cold storage.

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**References**

1. Assotech, US Commercial Service, Reed Analysis  
2. YES Bank-Dutch Embassy Collaborative Study  

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