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# **WP 2.4 : Sustainable Refrigerated Road Transport**

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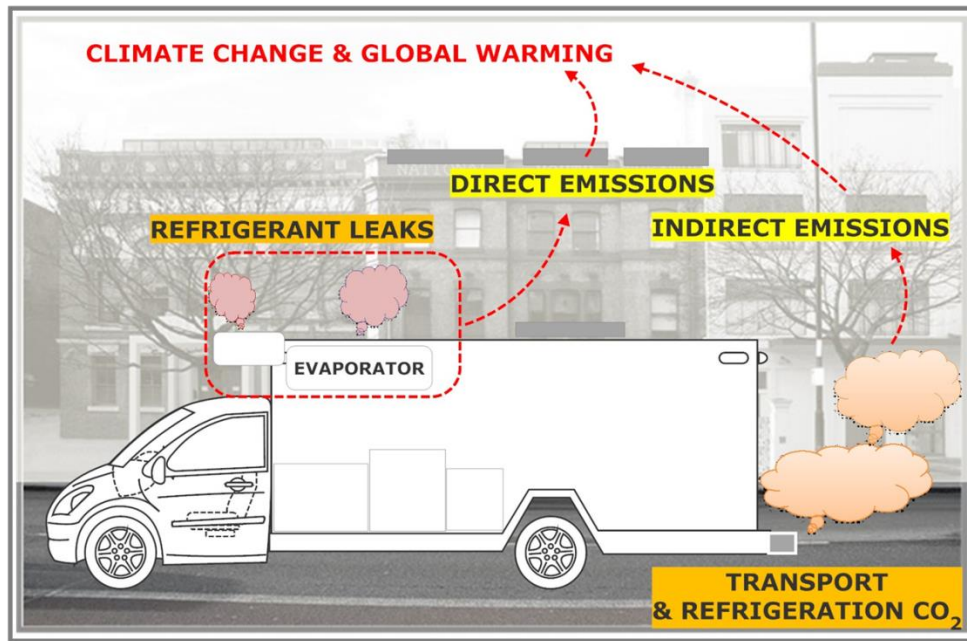
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## **Overview**

- 1. Reasons to Investigate**
- 2. Research Objectives and Deliverables**
- 3. Project Plan Flow Chart & Schedule**
- 4. Activities Completed to Date**
- 5. Next Immediate Steps**
- 4. Summary**



## Reasons to investigate refrigerated road transport (RRT)



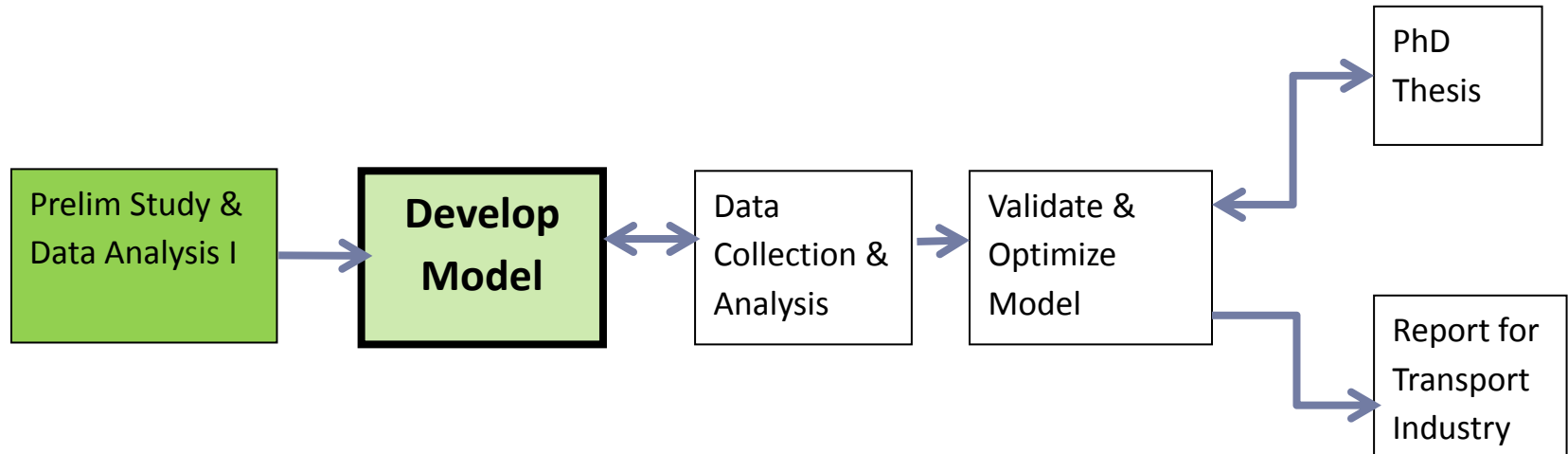
- UK primary food distribution by refrigerated road transport (RRT) uses 40% more energy than comparable non-refrigerated vehicles
- UK HGVs accounts for 2 Mtonnes of indirect CO<sub>2</sub> emissions from the engine alone.
- RRT units leaks up to 30% of their total refrigerant charge per year
- Revised F-Gas regulations RRT units will now need to be leak tight.

## Research Objectives/ Deliverables:

1. Examine different types RRT vehicle designs and the technologies currently used
2. Analyse existing maintenance and leakage records to:
  - a) Identify problematic components/ sources of refrigerant leakage
  - b) Suggest generic solutions for leak tight systems
3. Develop a predictive model to simulate a variety of scenarios of RRT systems to;
  - a) Estimate respective direct and indirect carbon emissions
  - b) Evaluate the effectiveness (in terms of energy intensity )of various designs – proportion of chilled vs. frozen
  - c) Determine relative operational costs of various designs
4. Identify RRT samples and collect actual data using appropriate instrumentation and controls (IC)
5. Validate and optimise model
- ▶ 6. Industry Report & PhD Thesis



## Project plan flow chart

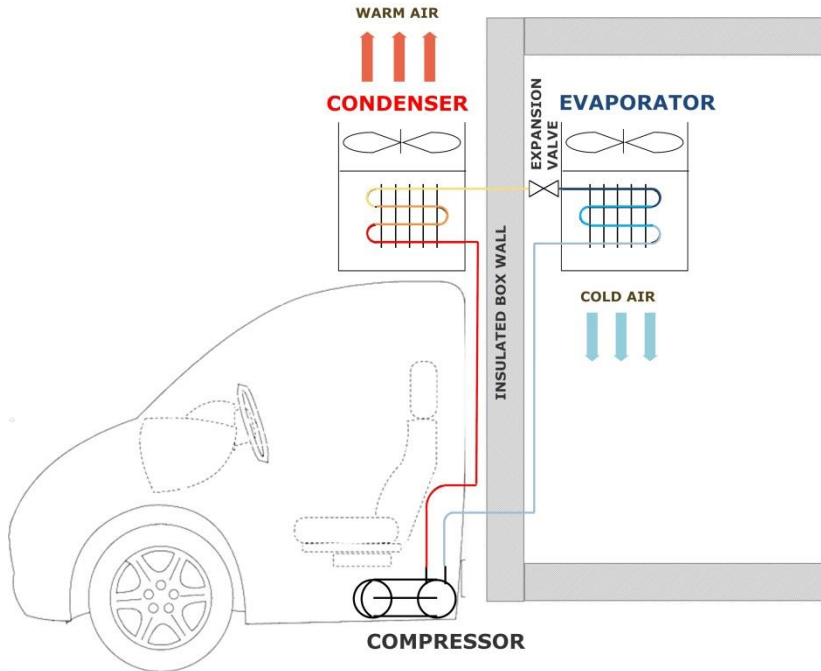


# Project Milestones

W.P.	Activities	Duration	Milestones
2.4.2	Plan Project Research	Nov 2013 - Oct 2014	<ul style="list-style-type: none"> <li>LSBU Report – April 2014</li> </ul>
2.4.3	Prelim Study & Data Analysis	Jan 2014- Apr 2014	<ul style="list-style-type: none"> <li>Brief Industry Report – Feb 2014</li> </ul>
<b>2.4.4</b>	<b>Develop Model</b>	<b>May 2014 – July 2015</b>	<ul style="list-style-type: none"> <li><b>Interim Report – Jun/July 2014</b></li> <li><b>LSBU Report – Oct 2014</b></li> </ul>
2.4.5	Data Collection	Aug 2014- Aug 2015	<ul style="list-style-type: none"> <li>Report on Findings – Jan &amp; Jun 2015</li> <li>LSBU Report – April 2015</li> </ul>
2.4.6	Data Analysis	Aug 2015- Jan 2016	<ul style="list-style-type: none"> <li>LSBU Report – Sept 2015</li> <li>Demonstrate Model – Dec 2015</li> </ul>
2.4.7	Validate & Optimize Model	Jan 2016 – May 2016	<ul style="list-style-type: none"> <li>Interim Report – Mar 2016</li> <li>Completed Model– May 2016</li> </ul>
2.4.8	Compose PhD Thesis	Feb 2016 – Nov 2016	<ul style="list-style-type: none"> <li>LSBU Report – June 2016</li> <li>Viva – Nov 2016</li> </ul>
2.4.9	Compose Industry Report	Jun 2016- Oct 2016	<ul style="list-style-type: none"> <li>Final Industry Report– Oct 2016</li> </ul>



## LEAK TIGHT SOLUTIONS



Refrigerant Leakage in RRT units remains a common issue due to the greater vibrations and shocks experienced relative to stationary refrigeration systems.



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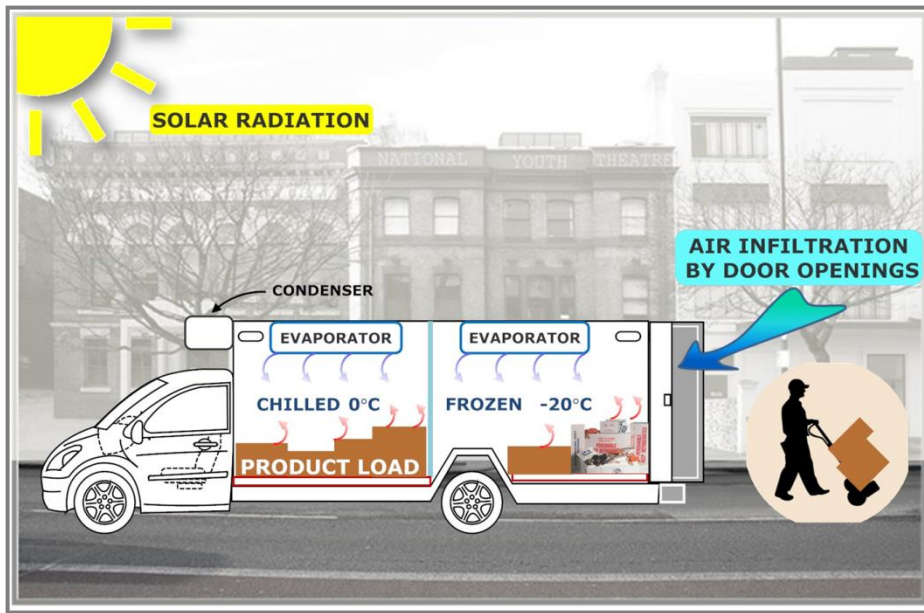
## **Other Activities Completed**

- Maintenance Routine site visit with a RRT service engineer
- Attended Commercial Vehicle Show & Multimodal Expo
- Site visit to Solomon's Commercial Body Builders
- Site visit to Hubbard Transport Solutions





## ENERGY SAVING OPTIONS



- Up to 50% energy savings can be achieved for refrigerated goods transport.
- Energy saving options may include:
  - modulating refrigeration power to meet part load requirements;
  - coordinating delivery logistics,
  - utilizing alternative refrigeration methods;
  - enhancing design features.

## Next immediate steps

- Refrigerant Leakage Data Analysis
- Review existing models applied to analysis of RRT units  
Of interest are:
  - a) Coolvan program- Mathematical model
  - b) Dymola-Modelica language - Numerical model
  - c) Commercial Transport Refrigeration Models such as:
    - ✓ Mistral,
    - ✓ ThermosysTM- Model for Heat Mode & Cool Mode



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## Summary

Sustainable Refrigerated Road Transport Project will :

- Review a holistic approach for reducing Transport Refrigeration CO<sub>2</sub> emissions
- Explore leak tight solutions
- Develop a model to investigate energy efficient solutions

