



Pump Priming Fund Round 1

REEF-UKC Workshop– June 19, 2025

AI-Assisted Digital Twin of a Solar-Powered Refrigeration System for Clean Refrigerated Transport in UK

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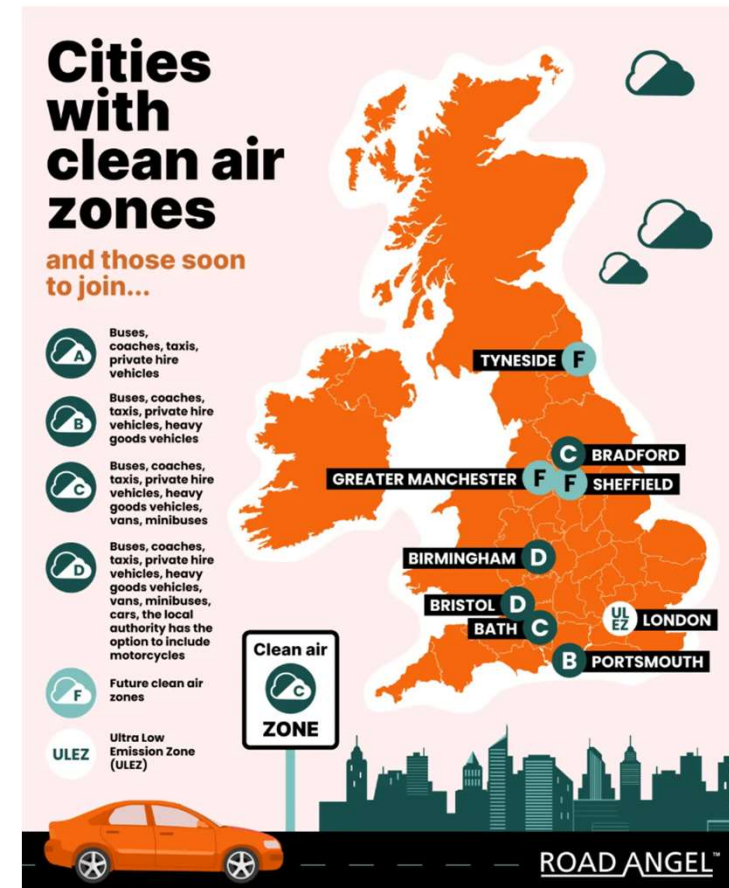
The Pain Point...

A reliable electrical supply is required to electrify logistic fleets

Lack of regulation on refrigerated vehicles relating to vehicle fuel.

The UK's demand for emission-free cooling transportation

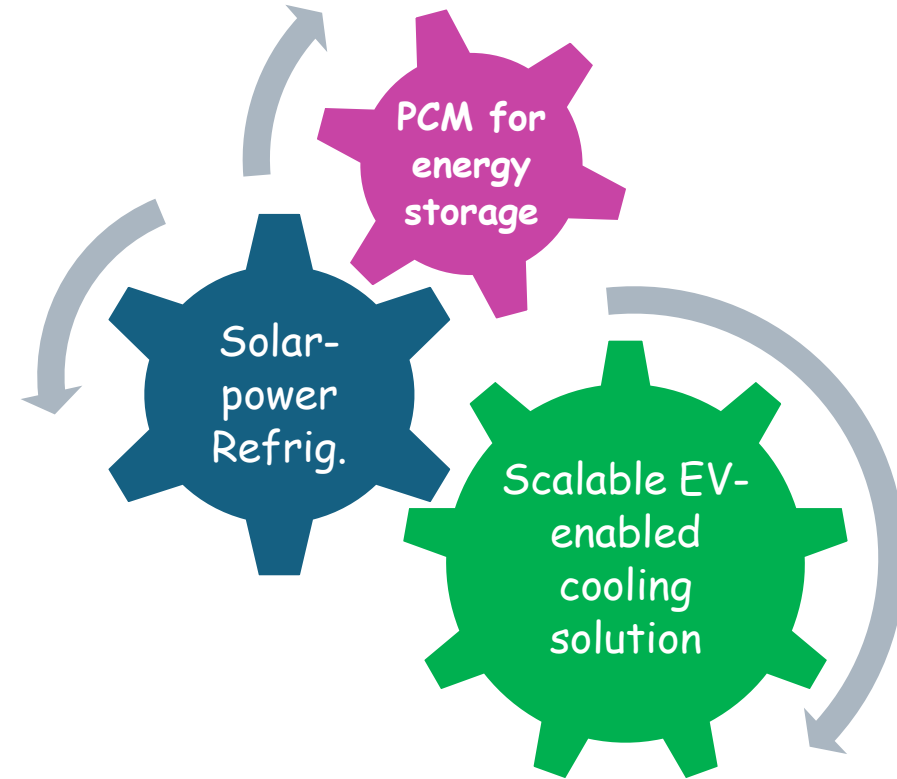
Developing finance models for the move to Net Zero cooling



Our Solution...



Traffic Data

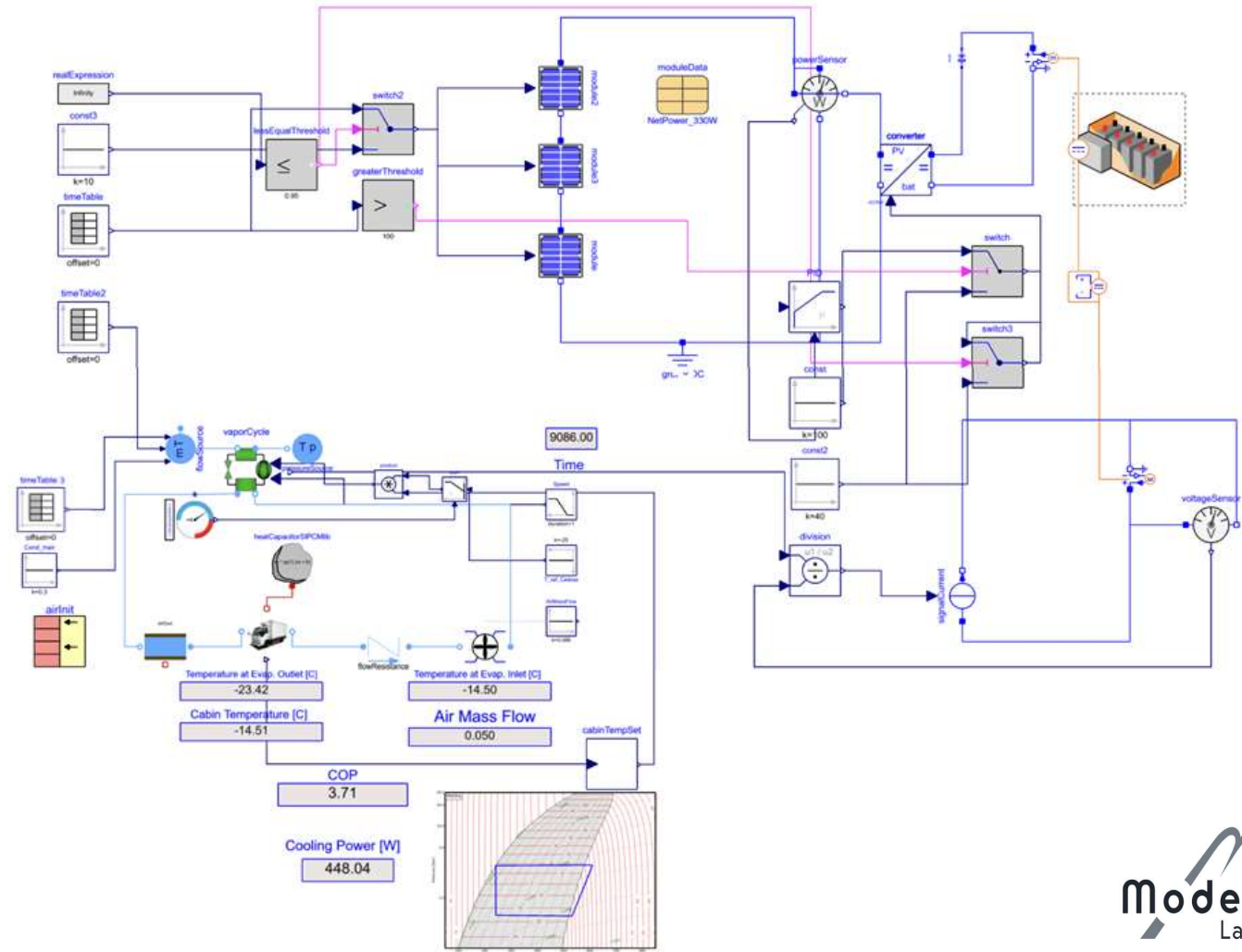


Objectives

1. To develop a digital twin to optimize performance
2. To create primary business models
3. To establish policy guidelines for uptake

Digital Twin

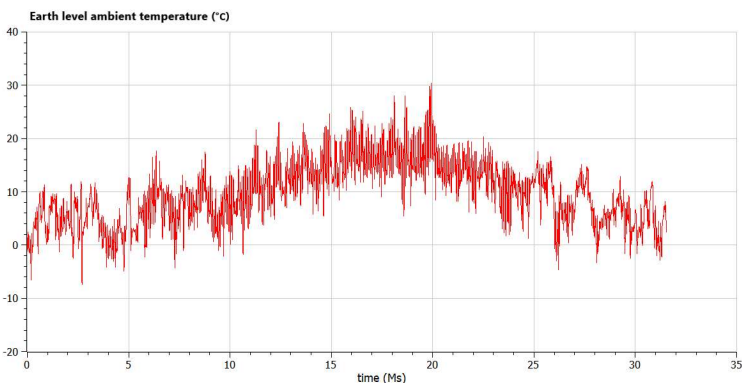
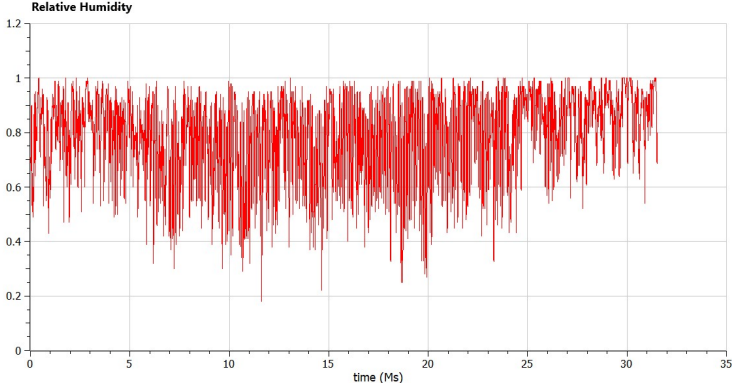
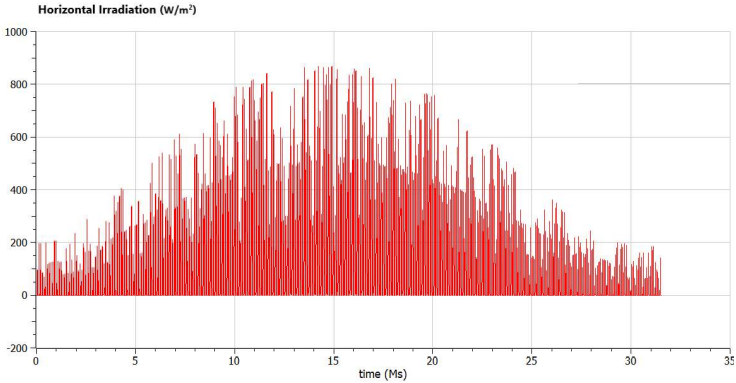
- PV panels
- Lead Acid Battery pack
- Refrigeration unit (R1234yf)
- PCM boards



Meteorological Data

Station Details:

- **City:** Birmingham
- **Country:** GBR (United Kingdom)
- **WMO Station Number:** 035340
- **Latitude:** 52.45° N
- **Longitude:** -1.73° E
- **Elevation:** 0.0 meters
- **Time Zone:** 99.0 (usually UTC offset)



Refrigerant: R1234yf

PHYSICAL PROPERTIES	UNITS	R-1234yf
Molecular weight	(g/mol)	114.0
Boiling point	(°C)	-29.4
Critical temperature	(°C)	94.7
Critical pressure	(bar)	33.81
Critical density	(Kg/m ³)	475.55
Vapour pressure (21,1°C)	(bar)	6.07
Vapour pressure (54,4°C)	(bar)	14.2
Density	(Kg/m ³)	1100
Solubility in water (24°C)	(mg/l)	198.2
Sliding temperature or glide	(K)	0
Safety classification		A2L
Lower flammability limit	(Kg/m ³)	0.289
Auto-ignition temperature	(°C)	405
ODP	-	0
GWP	-	4 *

* According to IPPCC-AR4/CIE (Fourth Assessment Report of the Intergovernmental Panel of Experts on Climate Change)-2007.

PCM for cold storage



PureTemp-21 is an organic PCM manufactured by PureTemp LLC. It has a phase change transition enthalpy of 238.6 J/g and nominal phase change peak temperature of -20.94 °C for heating. It is produced and delivered as bulk material, microencapsulated and macroencapsulated.

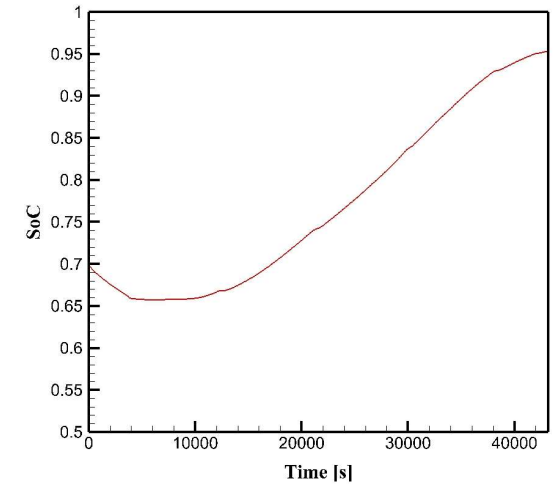
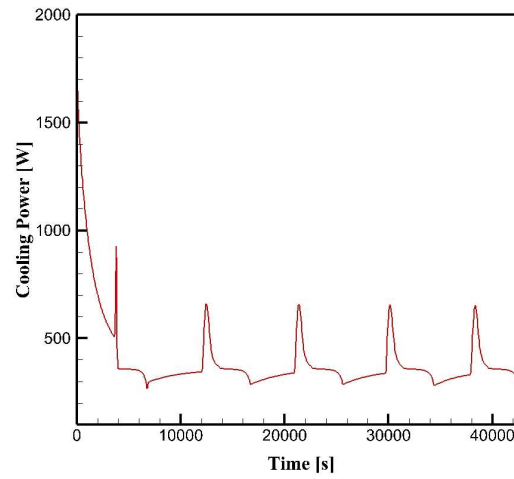
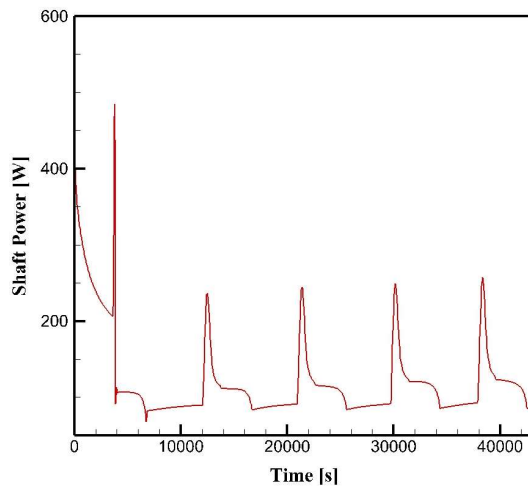
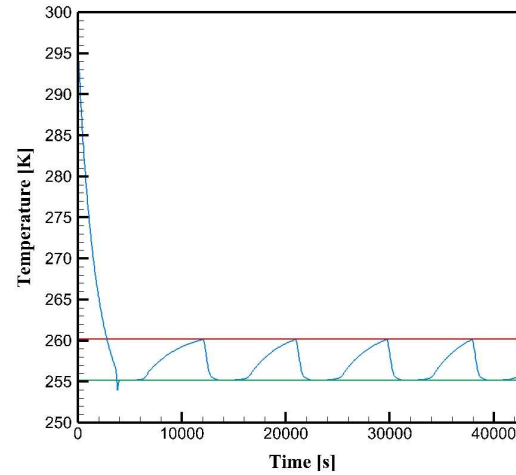
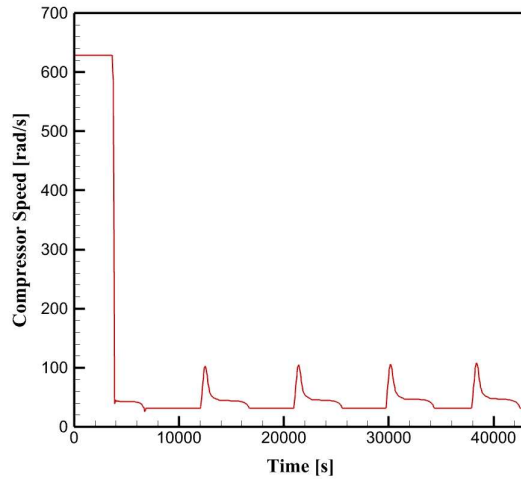
Manufacturer	PureTemp LLC	(Nominal) phase change temperature	-21.0 °C	Density (solid liquid)	1170.0 g/dm ³	1060.0 g/dm ³
Product family	PureTemp	Phase transition enthalpy	238.6 J/g	Specific heat capacity (solid liquid)	1.83 J/(g·K)	3.43 J/(g·K)
In-/Organic	organic	Phase transition range melting	[-27.1 → -8.9] °C	Thermal conductivity (solid liquid)	2.39 W/(m·K)	0.55 W/(m·K)
Material class	unknown	Phase transition range solidification	no data	Dynamic viscosity (solid liquid)	no data	no data
Encapsulation	multiple options available	Heat capacity measurement method	hf-DSC 1.0 K/min	Linear expansion coefficient (solid liquid)	no data	no data
Delivery/ Packaging	bulk material, microencapsulated and macroencapsulated	Data given as partial enthalpies	false			

Results



Eja-iCe

Without PCM



Results

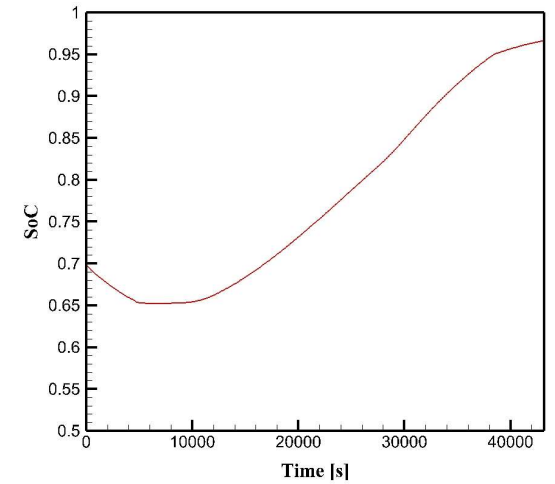
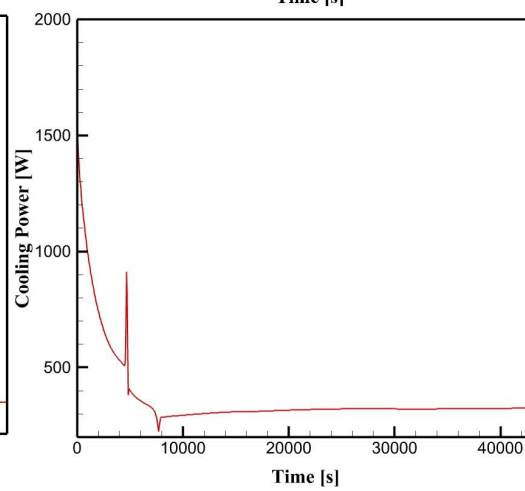
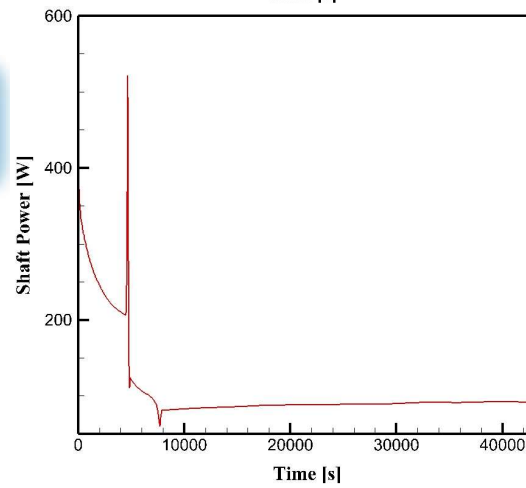
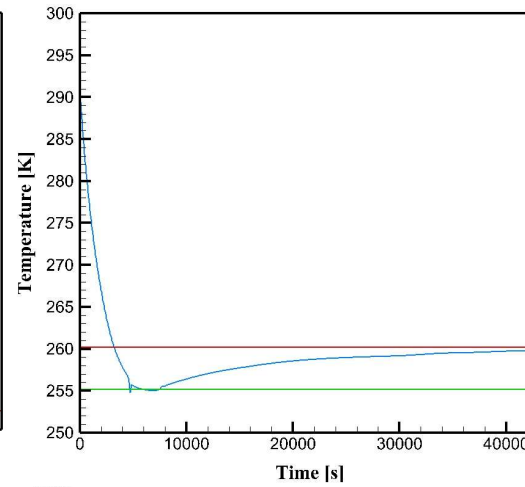
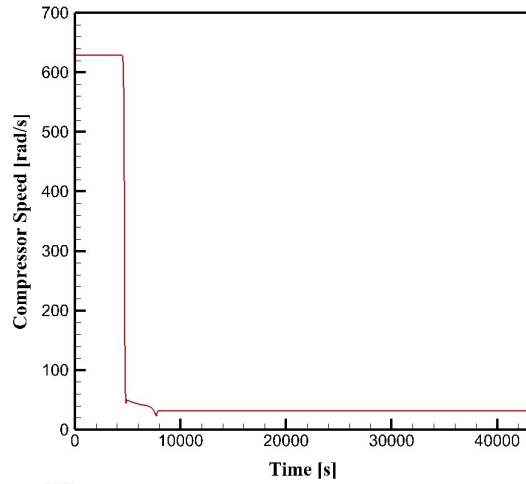


Eja-iCe 

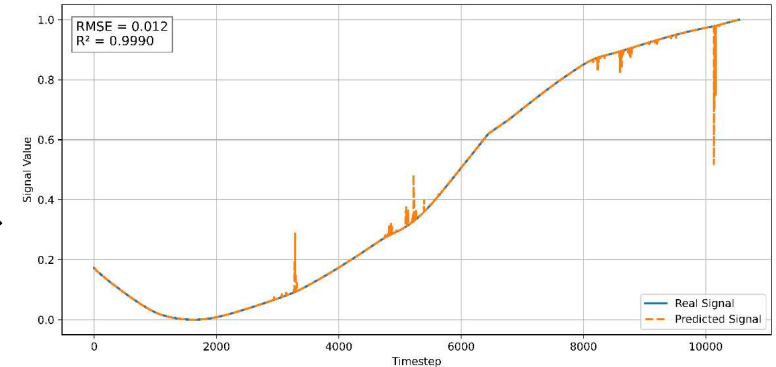
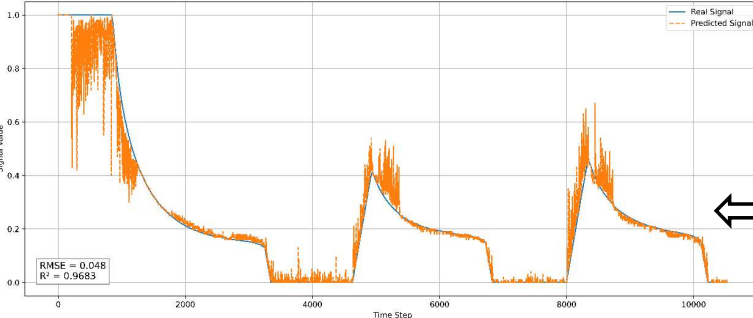
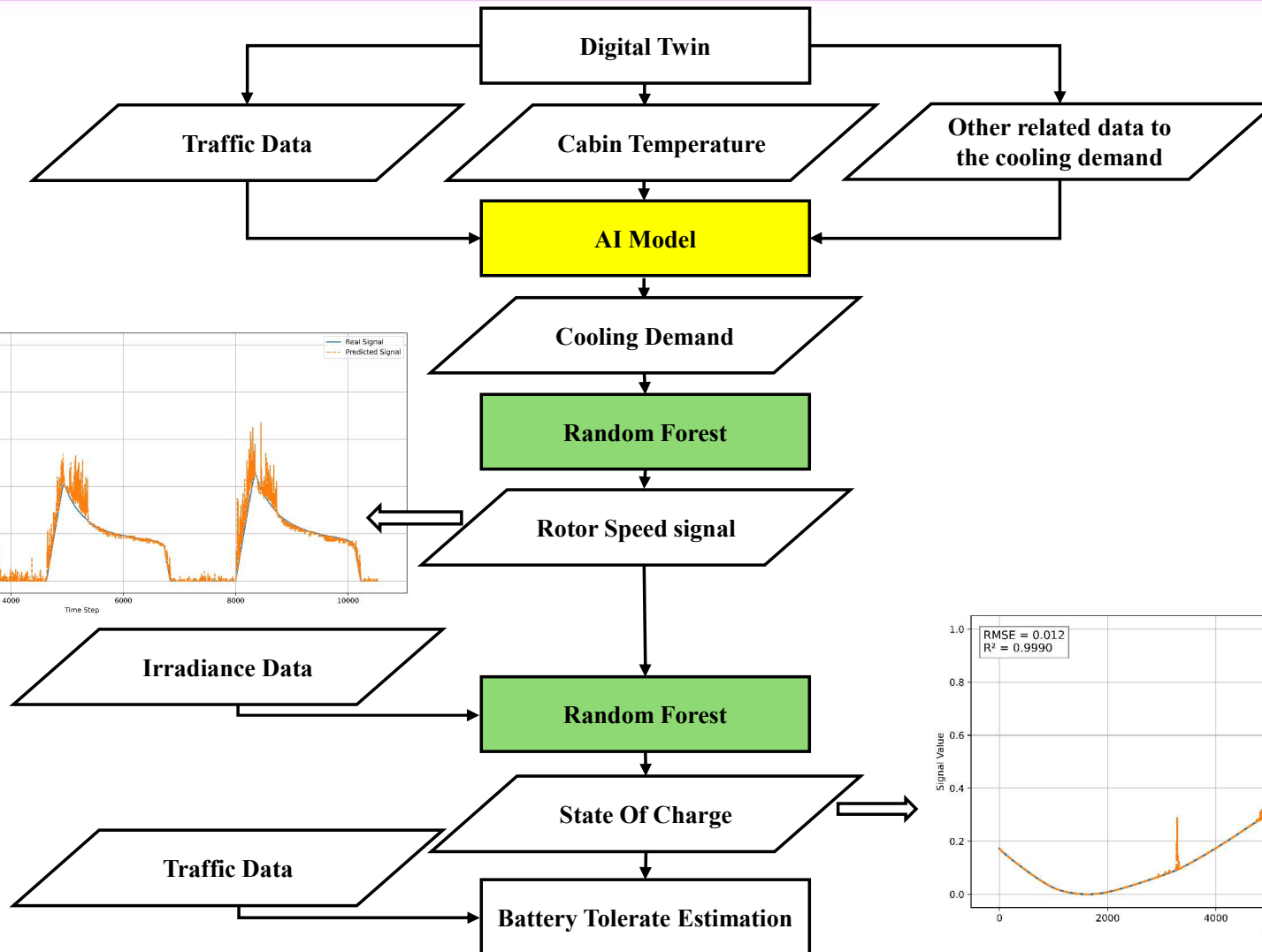
With PCM

 PureTemp

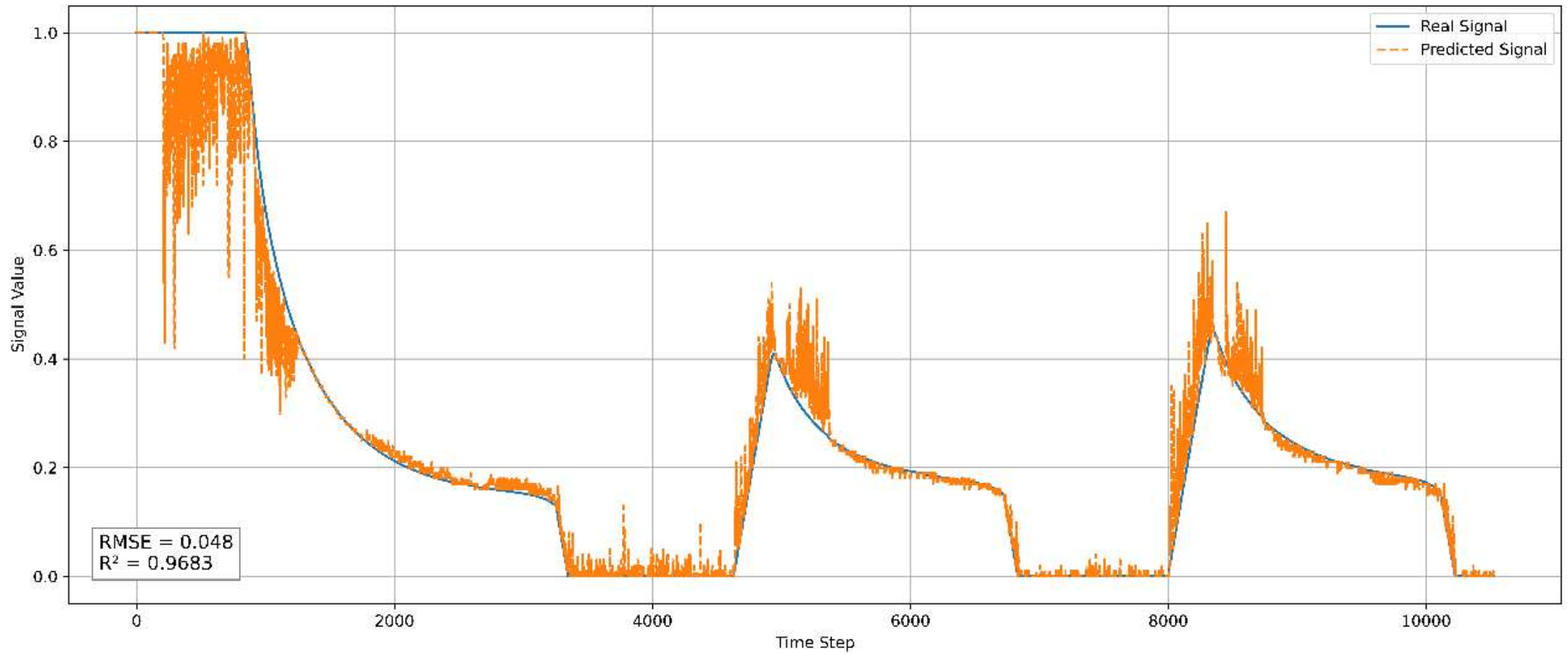
25% less power consumption



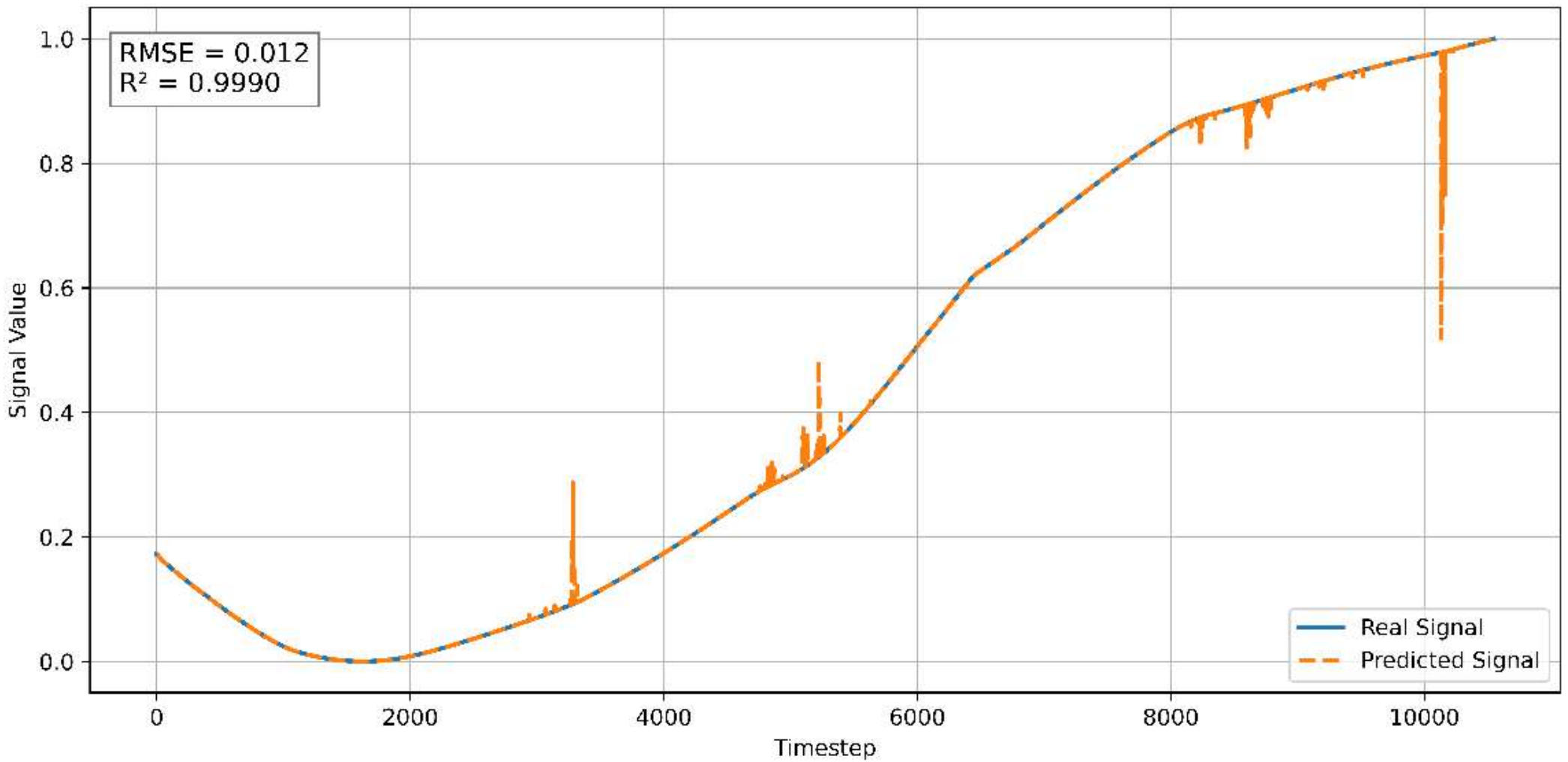
AI-assisted Digital Twin



Compressor frequency - ML Algorithm (Random Forest)



Battery SOC- ML Algorithm (Random Forest)





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Thank you

Advisory Board

- Dr Ahmed Rezk, Aston University
- Dr Gioia Falcone, University of Glasgow
- Dr Luciano Batista, Aston University
- Mr Yusuf Bilesanmi, Eja-Ice Ltd.