Electric Vehicle Charging within the ReFLEX project Orkney

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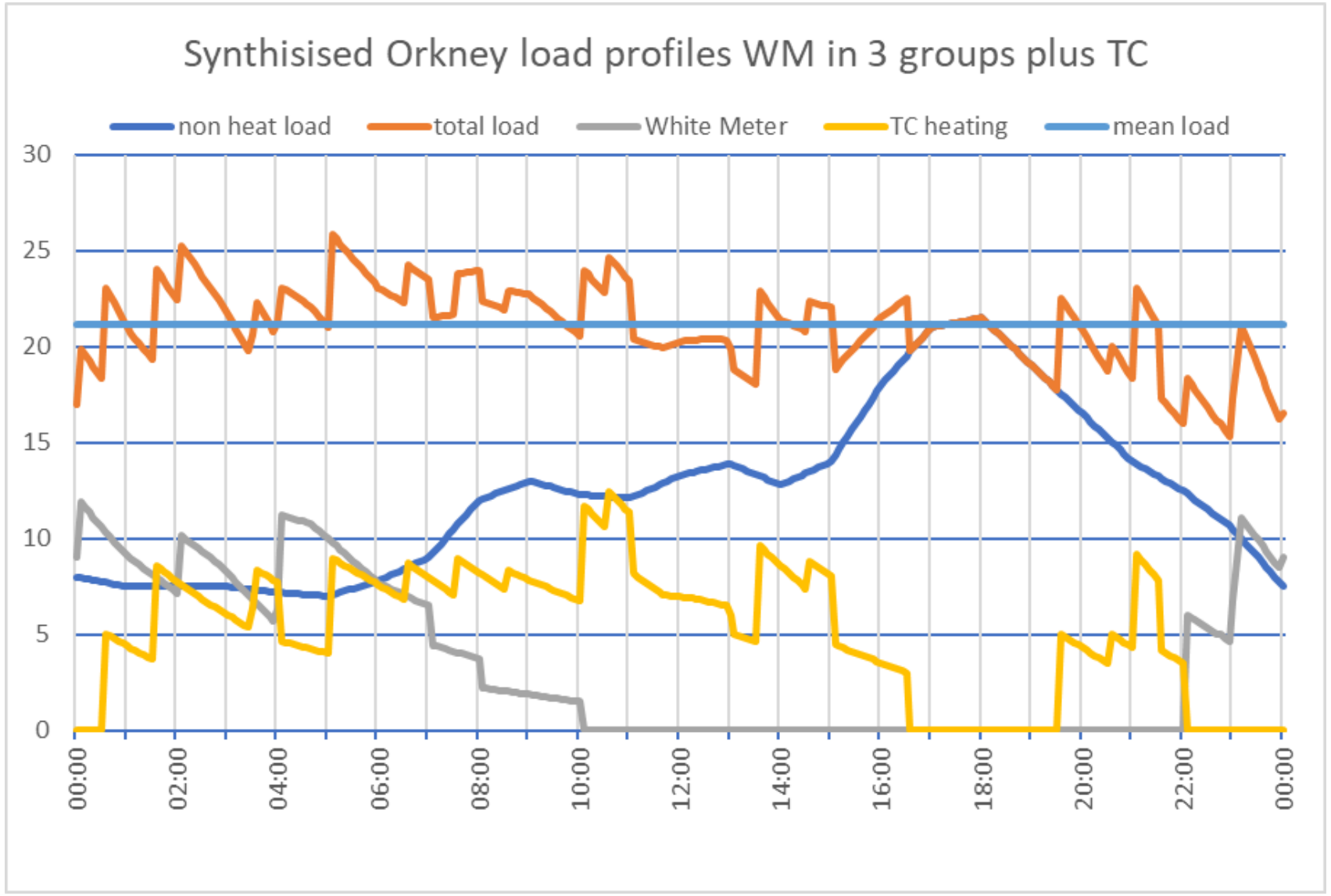
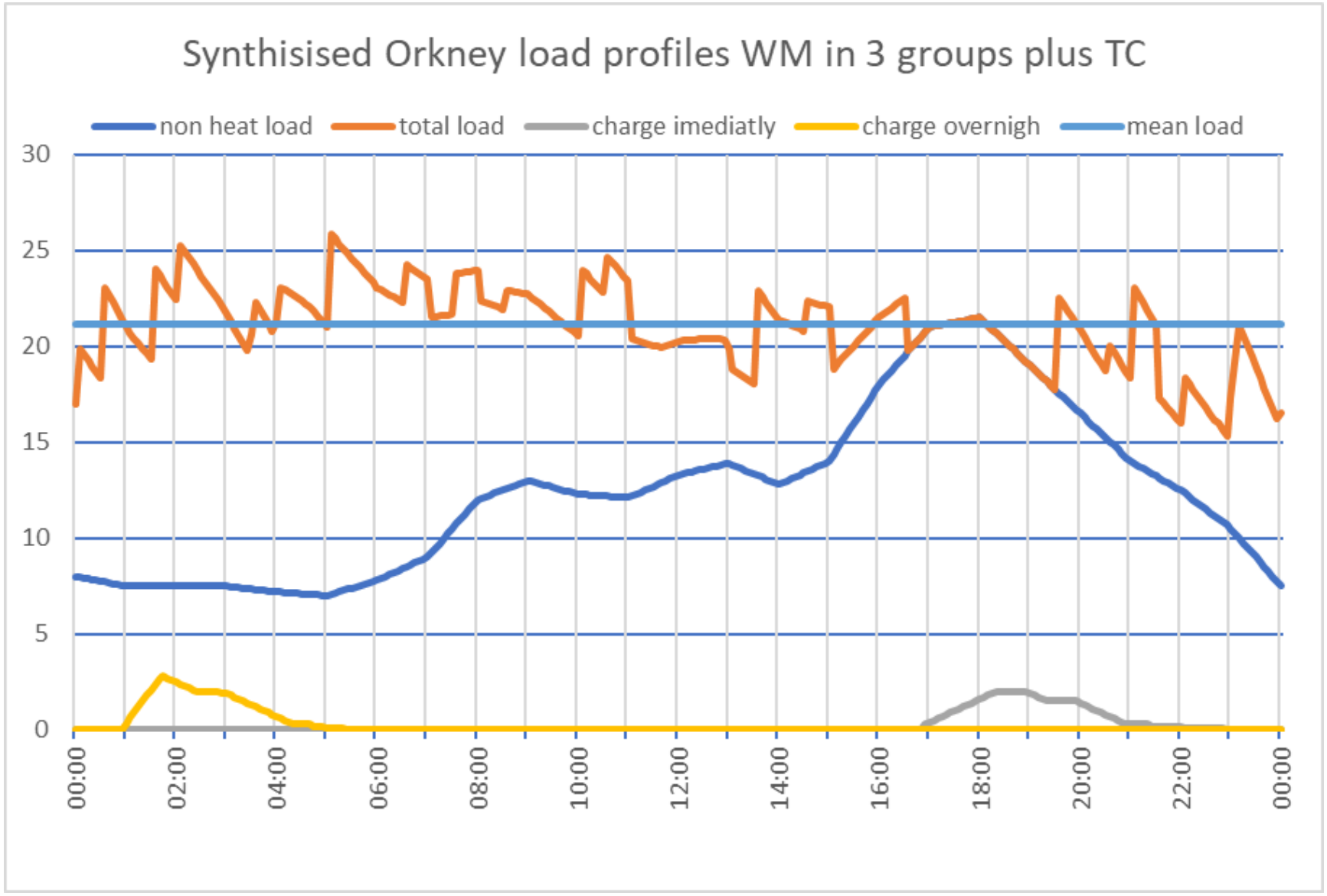
The ReFLEX project is looking to deploy up to 600 smart electric vehicle chargers across Orkney. Most of these will be deployed at peoples homes but some will be deployed at other suitable locations where people who can’t charge at home can charge.

In the next few slides, I’ll try and explain how the smart chargers will be operated in order to reduce energy costs and to allow many more EVs to be charged without needing grid upgrades, than would be the case if people were just to plug in and charge when they got home.

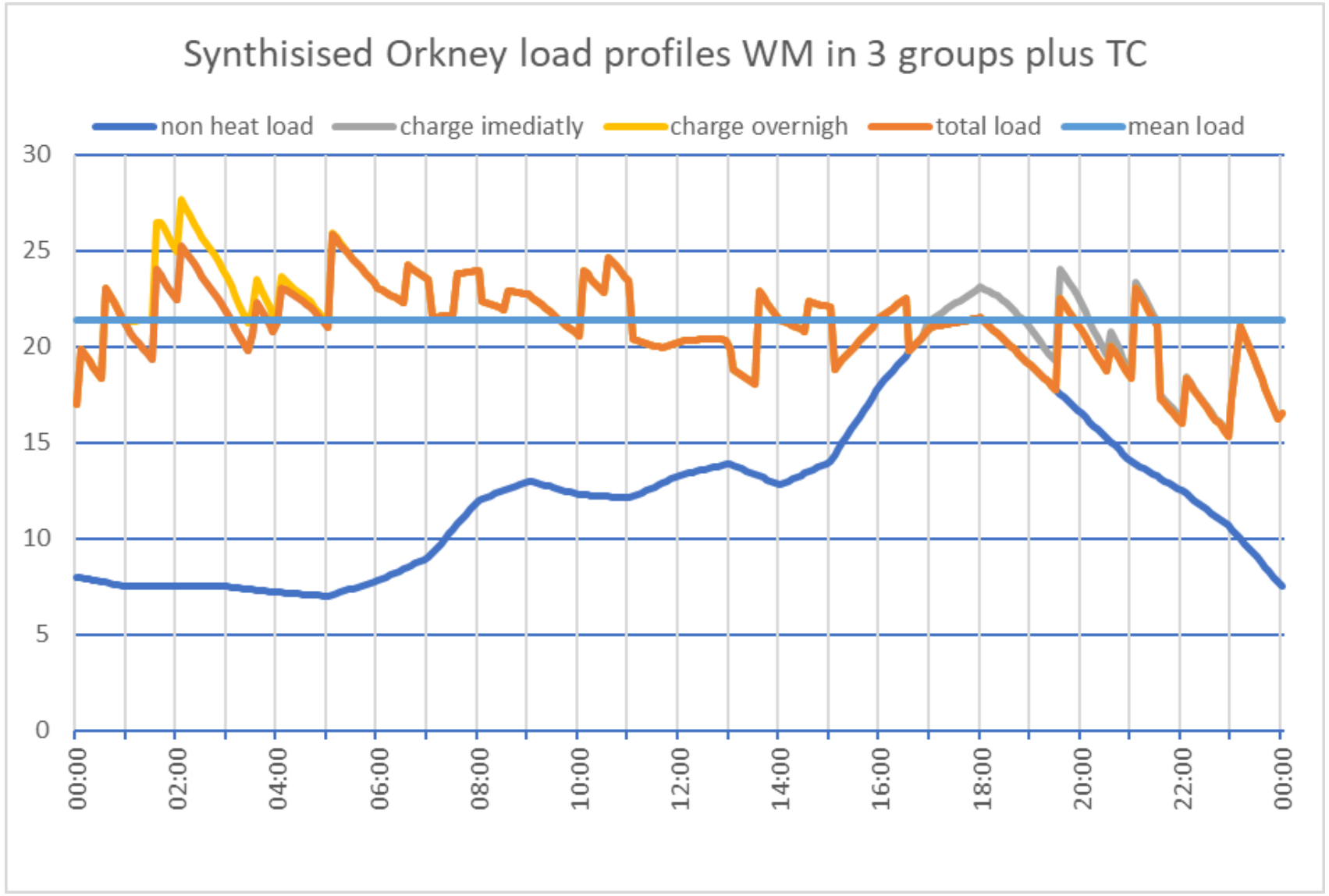
The first graph shows an indicative load profile for Orkney.



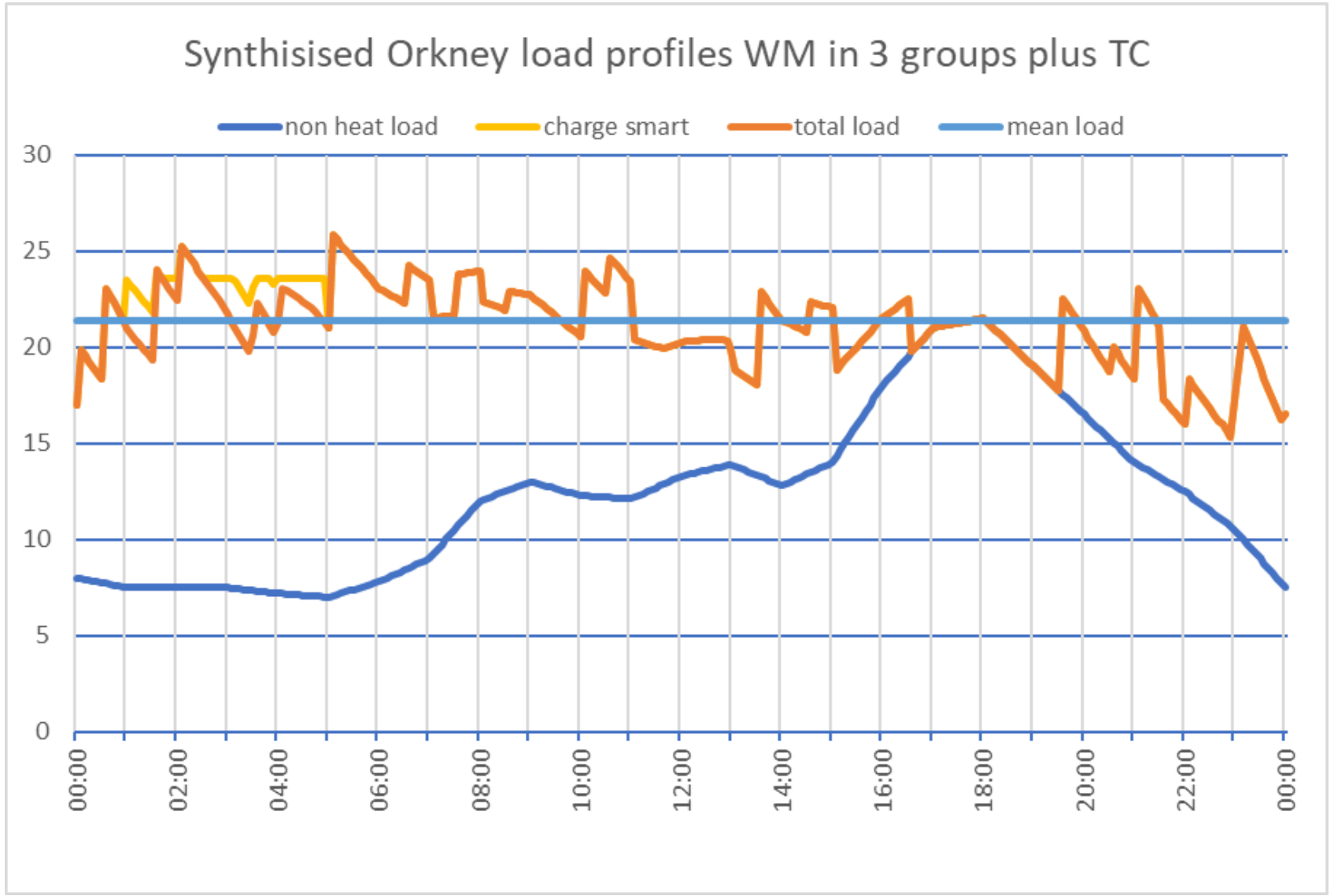
The conventional wisdom is that moving charging from when the EV is plugged in at around 5pm 6pm to a cheap rate period after midnight is required.
It wont work in Orkney



The two alternative charge times are shown on the bottom line.
When added to the total load they produce increases in Orkney either around 2am or
At 6pm and 7.30pm



In the overnight case the peak load has been increased, in the early evening case the load has been taken at what is generally the most expensive part of the day.



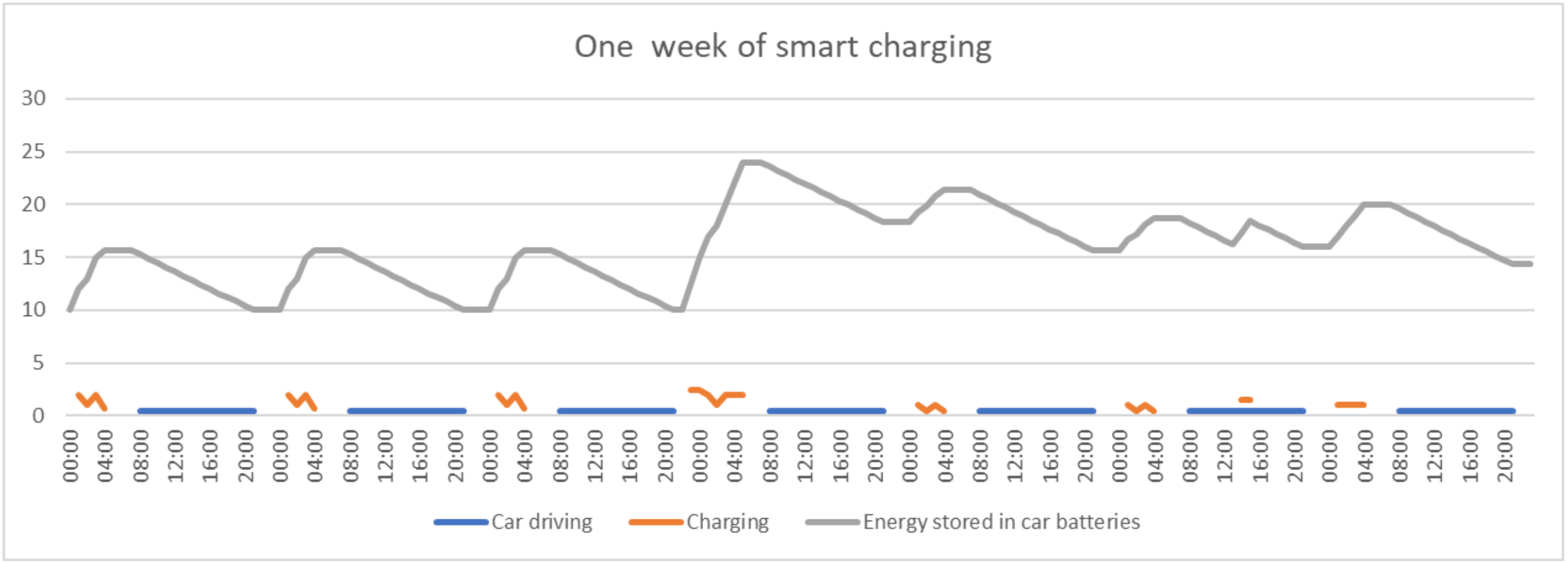
The aim of the ReFLEX project in terms of smart EV charging is to manage the charging to both prevent increases in network peak loads but also to maximise charging at times when electricity is cheap.

The graphs above represent 600 EVs with an average daily mileage of 34 miles and with a consumption of 3.6 miles per kWh.

This requires a daily energy consumption of 5.67MWh.

The storable energy in the 600 EVs is likely to be around 24MWh

There is therefore additional scope to keep an energy reserve in some cars so that they don't need charging every night. At times of high renewable output then all the cars can be fully charged to make best use of the renewable energy. The next graph is different to those I've already used and shows stored energy and renewable output. Driving is shown as an energy drawdown between 8am and 10pm



The first three days just show charging overnight without increasing peak load. Then on the next day substantial additional charging takes place to meet network demands, subsequent days have lower charging requirements. Day 6 has a charging period in the afternoon.

There will still be a need for rapid charger provision within Orkney along with some 22kW AC chargers for particular cars which can make use of them. There will also need to be some 7kW public charging to cater for people who can't have a charger installed at home, who are visitors to Orkney, or are carrying out unusual journeys, for example people from the outer islands visiting the Orkney mainland.

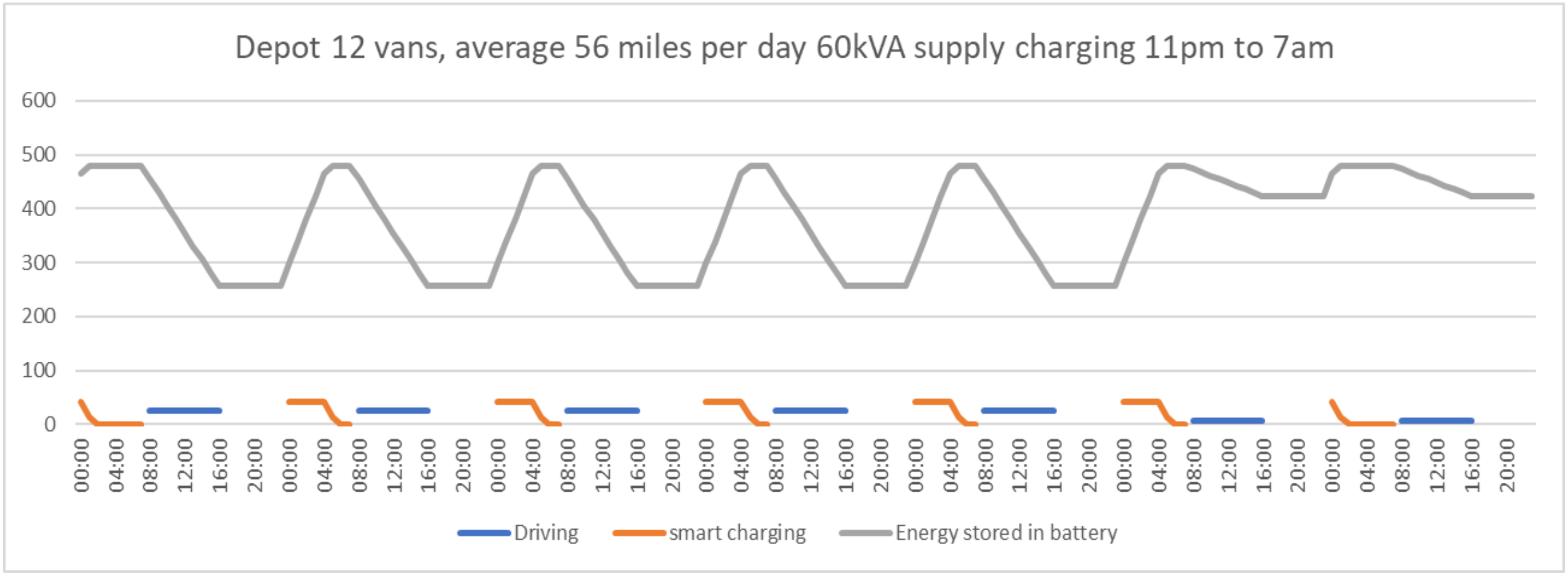
However it is expected that the majority of charging will be carried out by people plugging in when parked and interacting with the smart features brought in by the ReFLEX project to ensure that their car has sufficient charge at the right time for them to carry out the journeys they wish to make.

How can smart charging help with managing a fleet of EVs?

How can smart charging avoid or reduce the need for bigger electricity supplies?

If the users plug in their vehicle as soon as it is returned to the depot and provide an indication of how much charge is needed by a particular time, then both these aims can be achieved by using a smart charging system.

An assumption has been made that a depot has a 60kW three phase supply, but it is easy to scale.



If each vehicle actually did 56 miles then using slower 3.5kW chargers would produce the same result. A fully discharged vehicle would take up to 12 hours to charge and would need starting earlier or not be fully charged in the morning. This would not make best use of cheap rates.

The graph presented above makes sure each vehicle is fully charged by 7am. If you can accept more flexibility then not all vehicles need to be at 100% every morning. If one vehicle has a routine of 30 miles per day it could be run down during the week and fully charged over the weekend.

By building 7kW capacity into each charge point but managing the amount of charging at any time you can take away the management issues associated with EV charging with staff just needing to confirm that they have plugged in when parking the vehicle. Additional top ups during the day at about 20 miles in an hour would be available for some vehicles in a fleet.