Using citizen science to accelerate electric vehicle uptake in New Zealand

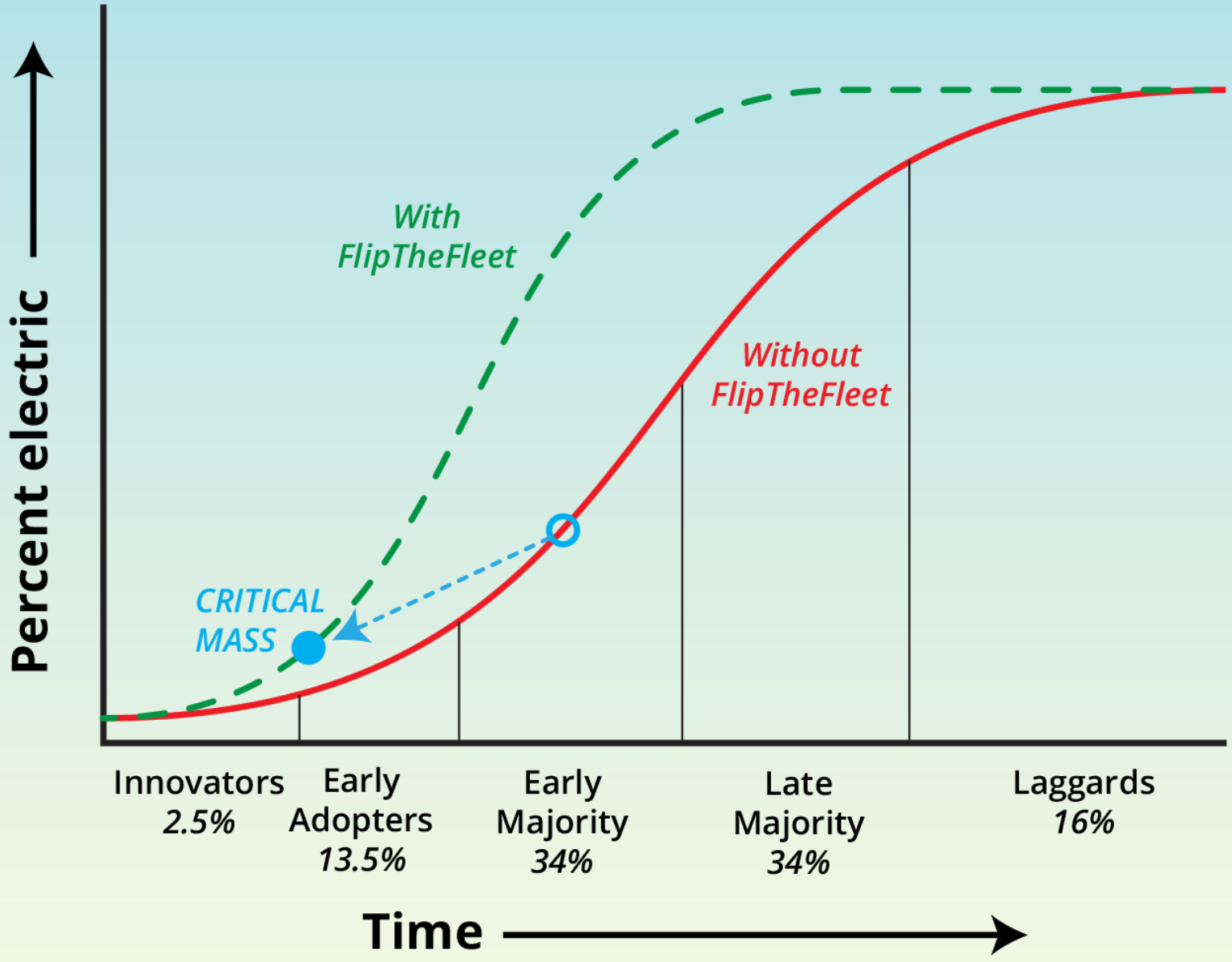
Henrik Moller, Dima Ivanov & Daniel Myall

Transport Knowledge Conference , Wellington,
15 November 2018

EVFLEET.ORG

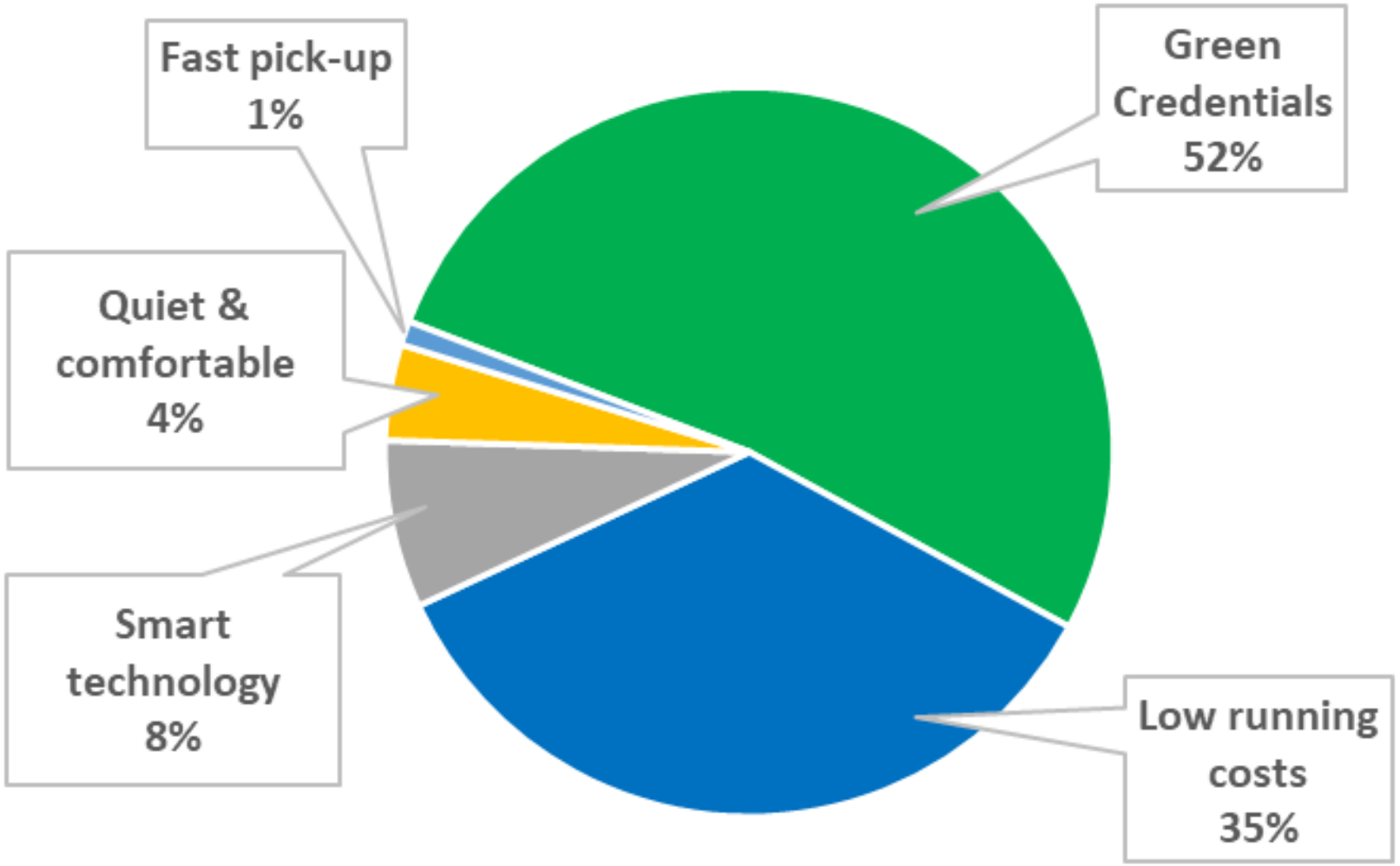
Citizen science
"by EV owners, for future EV owners"

- Public launch June 2017
- 1,200+ EVs signed-up
- 20 'fleets'
- 8,872 monthly records
- 8-20 KPIs per monthly upload
- >90,000 data points
- Monthly "1-click surveys"



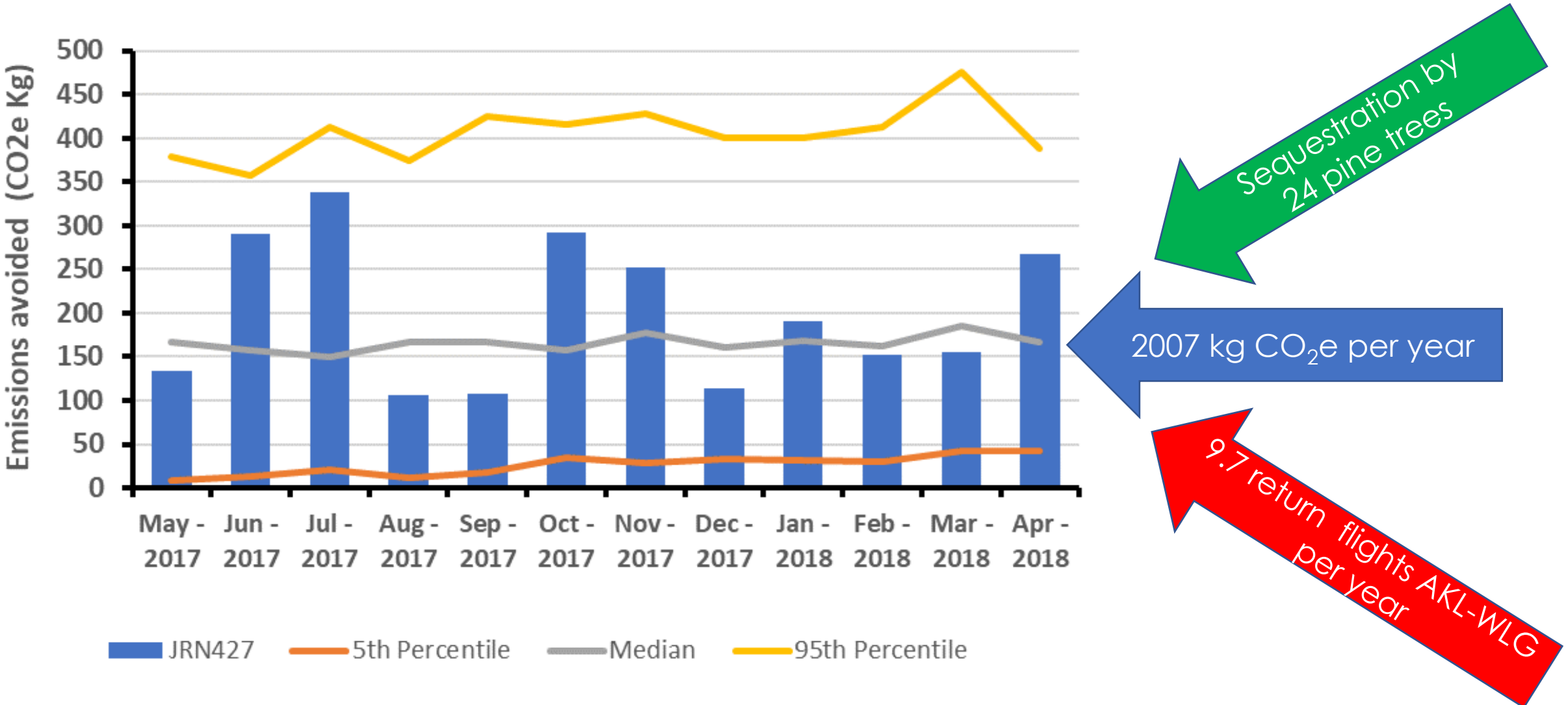
E. Rogers (2003) Diffusion of Innovations

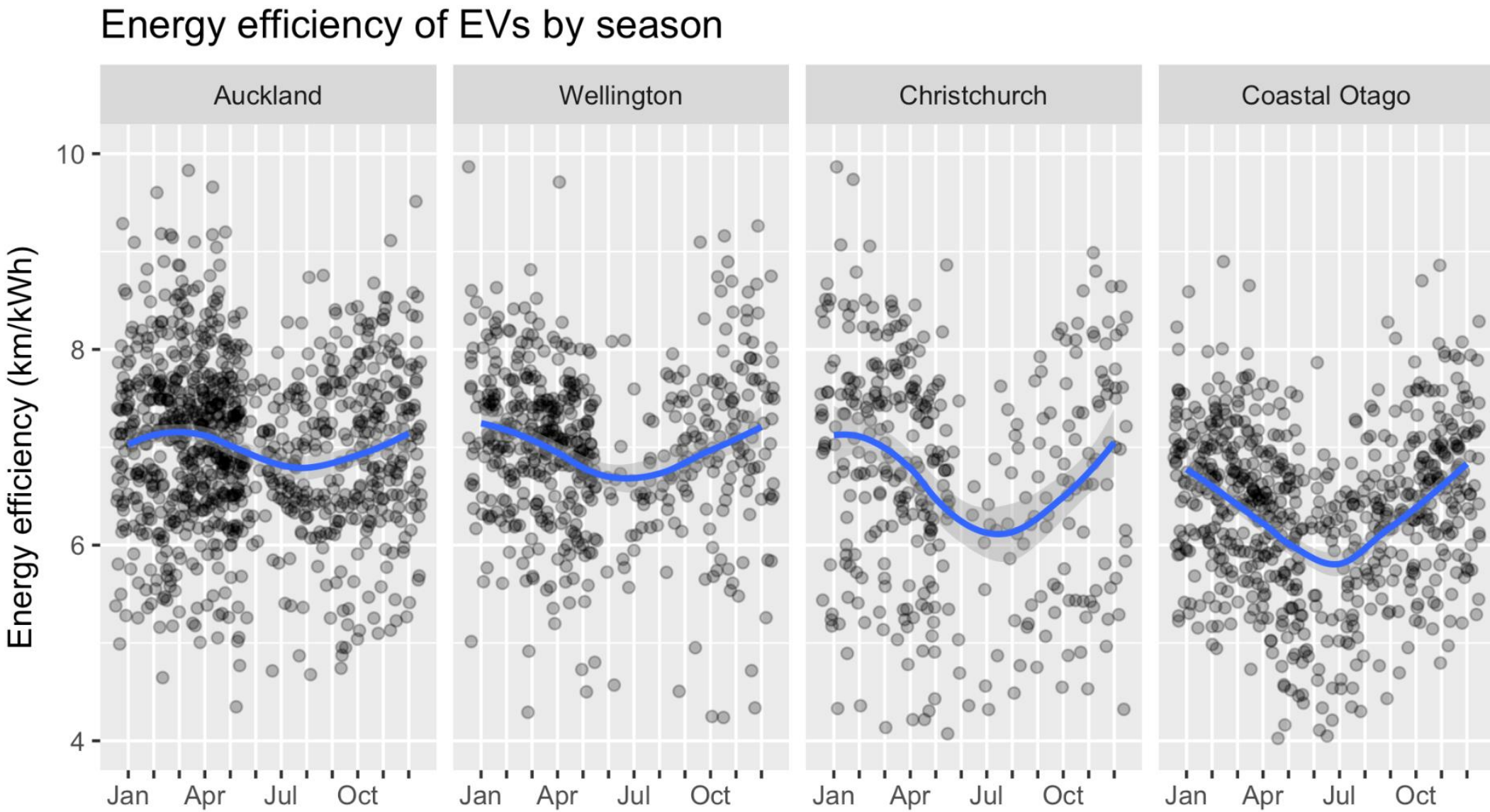
My most important reason for buying Battery Electric Vehicle was its …



Flip the Fleet
"1-Click survey"
April 2018,
n=391

Emission reductions JRN427 Nissan Leaf




Energy efficiency of EVs by season
Auckland
Wellington
Christchurch
Coastal Otago
Energy efficiency (km/kWh)
10
8
6
4
Jan
Apr
Jul
Oct

$0.30/L equivalent

$2.5/L of petrol

BEV: 1 c/km for repairs, maintenance and tyres + 3.6 c/km for electricity = 4.6 c/ km

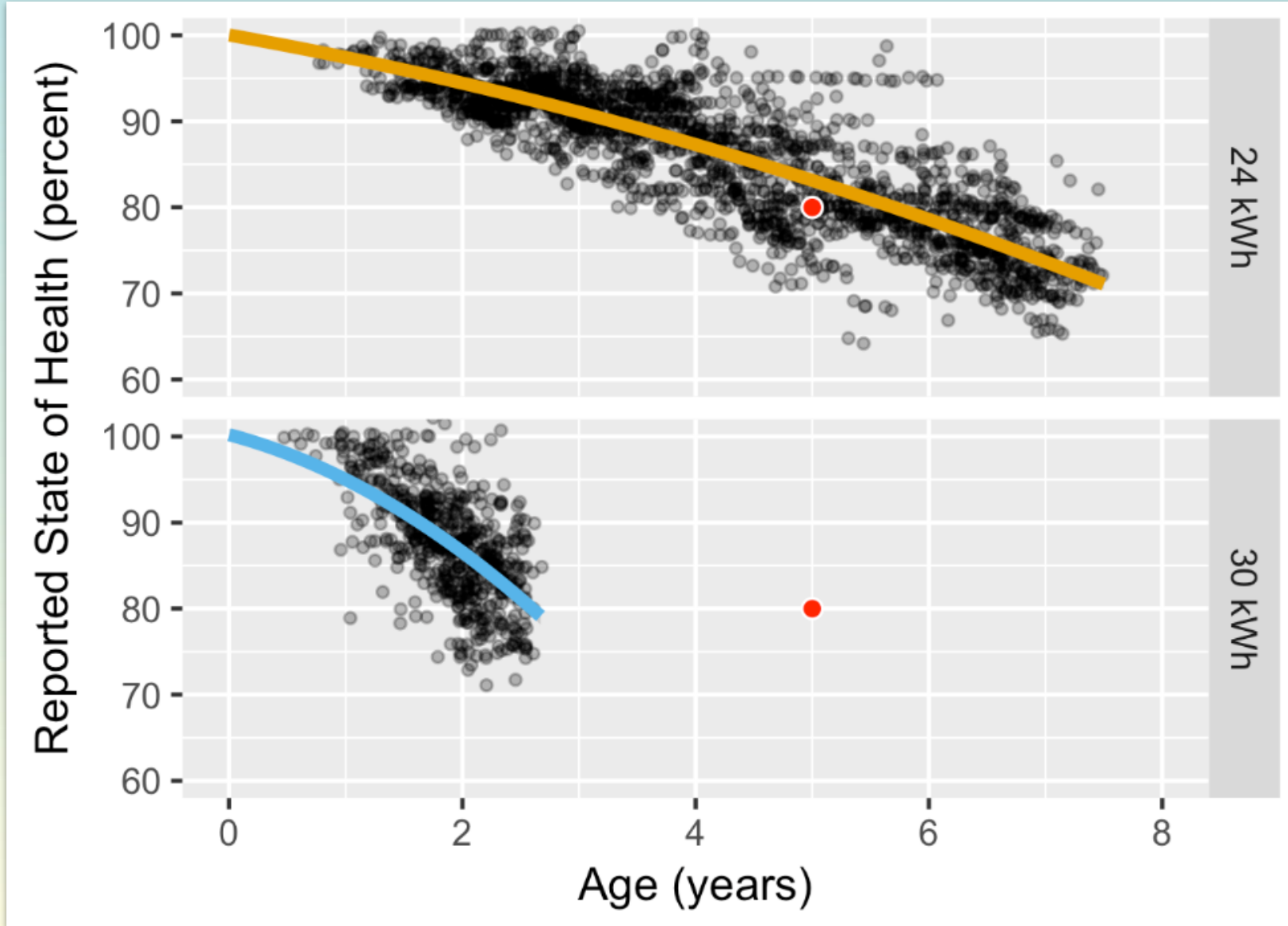
Middle-sized ICV: 6 c/km for repairs, maintenance and tyres + 13 c/km for petrol = 19.6 c/km

BEVs cost ca. 23% as much to run, excluding depreciation, taxes and battery replacement costs

An inconvenient discovery

By January 2018 rapid decline in SoH of 30 kWh Leafs became apparent

- initially n=26 of 30 kWh Leafs
- activation of citizen science panel to build sample size
- Bayesian hierarchical modelling showing accelerating decline in reported SoH



Open source publishing

15,199 views

3,157 downloads

18 peer reviews

Preprints

preprints.org > engineering > energy & fuel technology > doi: 10.20944/preprints201

Preprint **Article** *Version 1* This version is not peer-reviewed

Accelerated Reported Battery Capacity Loss in 30 kWh Variants of the Nissan Leaf

Daniel Myall * , **Dima Ivanov** , **Walter Larason** , **Mark Nixon** , **Henrik Moller**

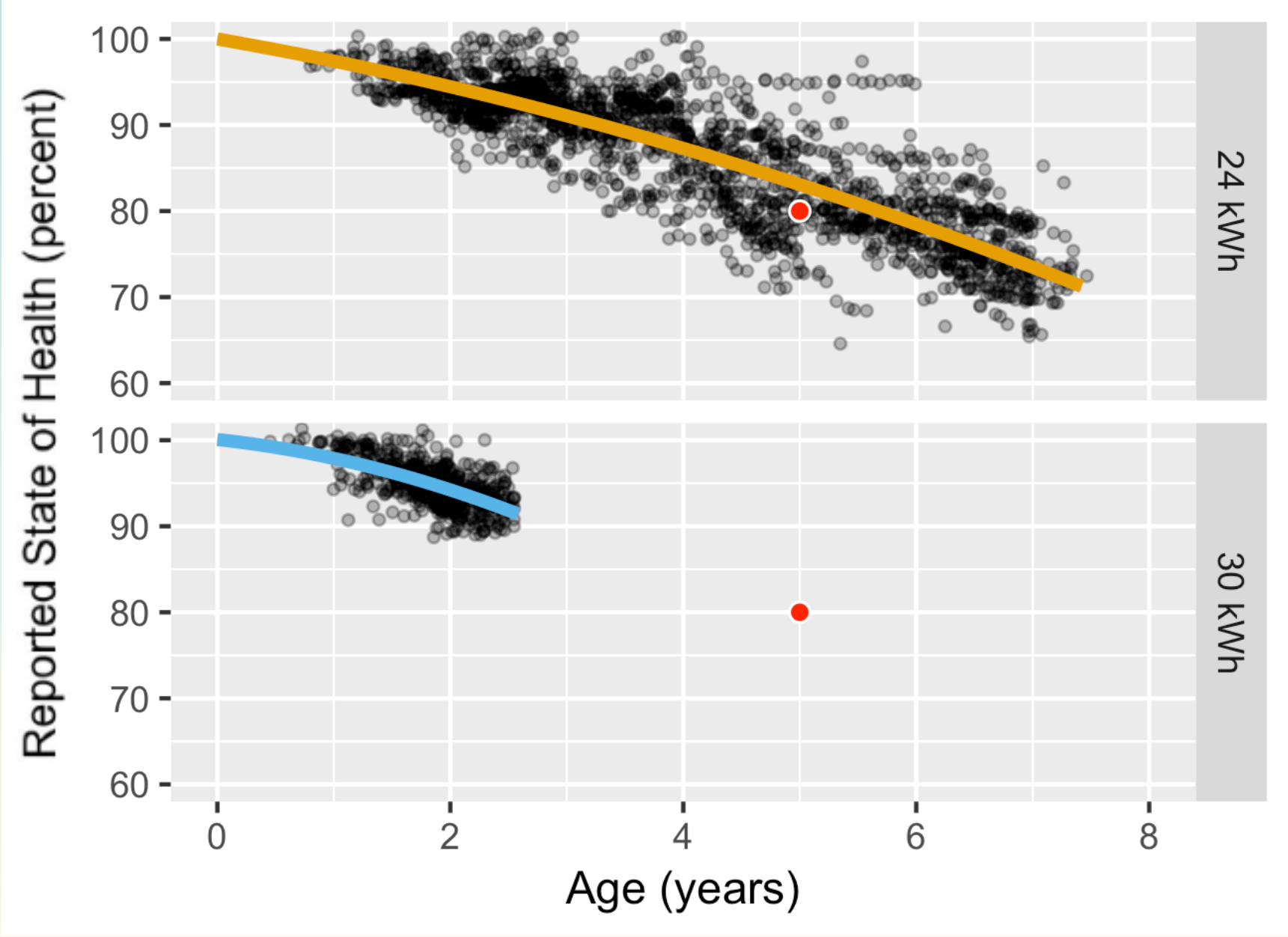
Version 1 : Received: 15 March 2018 / Approved: 15 March 2018 / Online: 15 March 2018 (07:19:52 CET)

How to cite: Myall, D.; Ivanov, D.; Larason, W.; Nixon, M.; Moller, H. Accelerated Reported Battery Capacity Loss in 30 kWh Variants of the Nissan Leaf. *Preprints* **2018**, 2018030122 (doi: 10.20944/preprints201803.0122.v1). Copy

Abstract

Instrumentation error?

Note: 30 kWh Leaf battery health has been retrospectively "corrected" by applying a firmware upgrade to historical *Flip the Fleet* data



Battery costs erode EV financial gains

Based on *Flip the Fleet*, June 2018 - Repairs and Maintenance Study

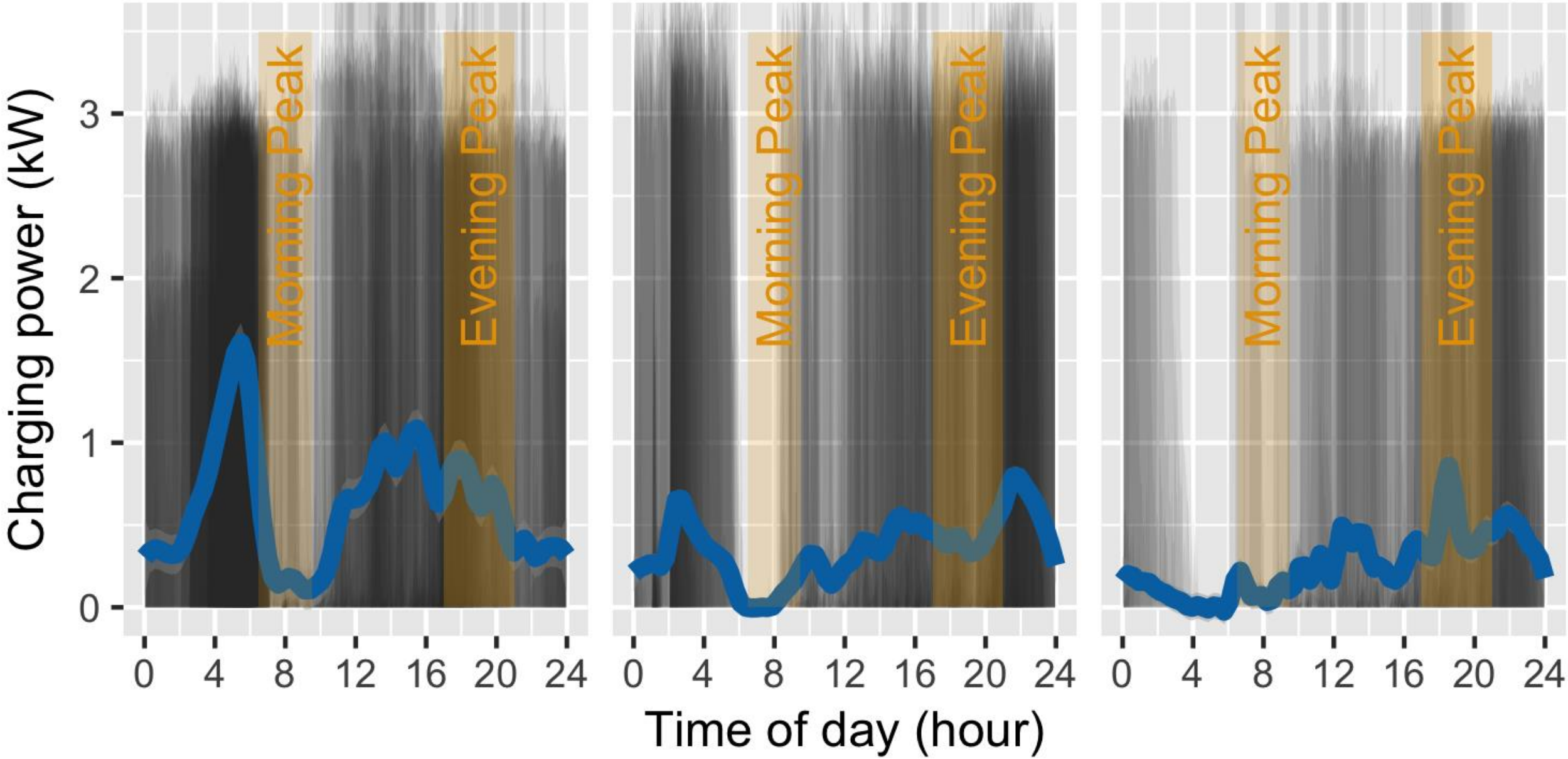
If battery refurbishment or replacement is not included, BEVs cost 13% of cost to repair and maintain compared to ICVs.

Table shows % of repairs and maintenance costs of EV compared to ICV when battery refurbishment or replacement costs are included

	Number of battery replacements				
Cost	1	2	3	4	5
$4k	31%	49%	66%	84%	102%
$6k	40%	66%	93%	119%	146%
$8k	49%	84%	119%	155%	190%
$10k	57%	102%	146%	190%	234%
$12k	66%	119%	172%	225%	279%

… by 4 Nov 2018 …

- 1.3 million records
- 230 data per record
- >300 million data
- 3.5 Gb


Charging power (kW)
0
1
2
3
Morning Peak
Evening Peak
Morning Peak
Evening Peak
Morning Peak
Evening Peak
0 4 8 12 16 20 24
0 4 8 12 16 20 24
0 4 8 12 16 20 24
Time of day (hour)

Weaknesses & threats

✗ Some wooze in the data

✗ Representativeness of information?

✗ Participant fatigue

✗ Managing imposition on participants

✗ Multiple agendas: clear partnership expectations and management

✗ Time consuming and under resourced

Opportunities & strengths

- ✓ Growing data depth, width and geographic spread
- ✓ Longitudinal data stream
- ✓ A mix of coarse and fine grained data
- ✓ A social research platform
- ✓ Pathway to uptake
- ✓ Relatively low cost now that FtF is established
- ✓ Independent research


independence
government
funding
industry
sponsorship
data
sell
people
EECA
selling
know
Grants
uptake
wrong
way
numbers
fuel
may
Mercury
currently
hard
beholden
companies
sources
sure
vested
pays
seen
power
stay
accepting
donate
business
credits
potential
give
believe
electricity
carbon
time
bit
maintain
vehicle
credibility
perhaps
Meridian
donations
free
EV
Sell
Selling
good
lose
suppliers
accept
think
money
even
environmental
Carbon
support
based
source
battery
provide
conditions
valuable
interests
charity
just
car
include
maybe
fossil
soon
might
impartial
service
keep
manufacturers
right
ask
compromise
important
taken
need
get
benefit
information
careful
conflict
long
analysis
promoting
one
related
fee
Stay
interest
commercial
advertising
grants
used
make
research
integrity
must
coming
Ideally
become

Thank you

The Flip the Fleet Team: 1200+ EV owners ● Dima Ivanov ● Henrik Moller ● Daniel Myall ● Vasily Levshin ● Pam McKinlay ● Jefferson Dew

Advisors: Walter Larason ● Mark Nixon ● Donald Love ● Joe Barnett ● Mike Bourke ● Kathryn Fitzpatrick

Information sharing: Saffron Byron (EECA)

Funders: Low Emission Vehicle Contestable Fund ● Energy Efficiency & Conservation Authority ● Otago Museum & the *Science into Action* partnership ● Unlocking Curious Minds ● Office of the Parliamentary Commissioner for Environment