Going forward, Electric / Hybrid / Hydrogen

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Geesink norba KIGGEN

Geesinknorba Group

Our mission: Driving Sustainability

We *engineer*, *deliver* and *service* solutions that help our customers to make our world a better and more sustainable place to live. A world in which we take better care of our resources and save time and effort doing so.

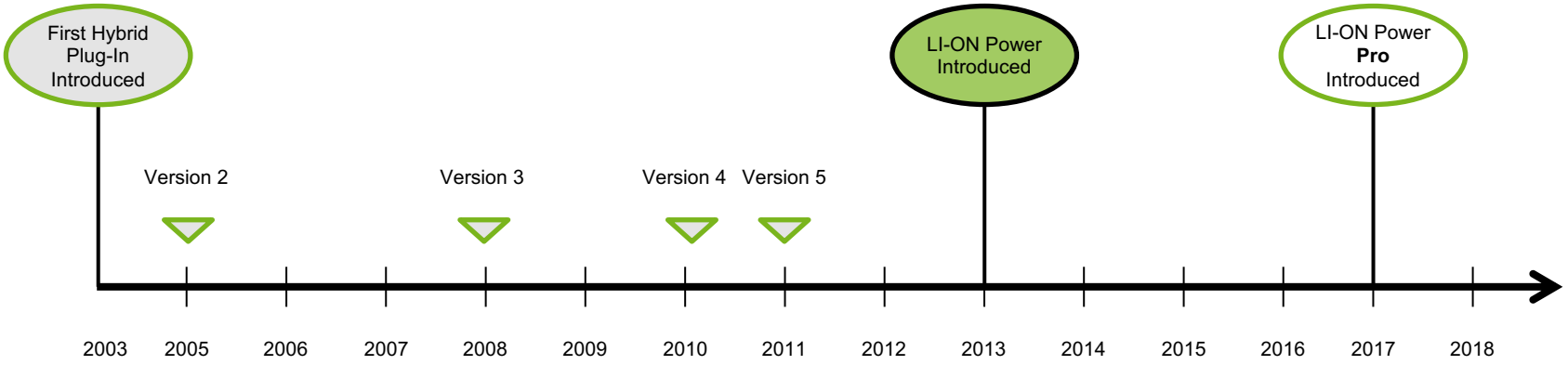
Electric technology developments

Hybrid plugin

LI-ON POWER

LI-ON Power Pro

Full Electric RCV



Lion Power, the hybrid solution

Body driven by battery pack (15kWh)

4 versions available:

1.	ST (Standard version)	wall charge and diesel charge
2.	CC (Chassis Charger)	wall charge and charge using the left over energy in the chassis
3.	CG(Chassis Generator)	wall charge and continuous charge using engine driven generator
4.	DBP (Double battery pack)	same as standard, only double size battery pack (30kWh) and higher capacity chargers

- Noise reduction
- Fuel reduction

LION POWER PRO, the Geesinknorba total solution

LION POWER PRO

Full Electric Chassis

GN Body

LION POWER PRO, the Geesinknorba total solution

Where can I find it?

What is a LION POWER PRO?

What does it do?

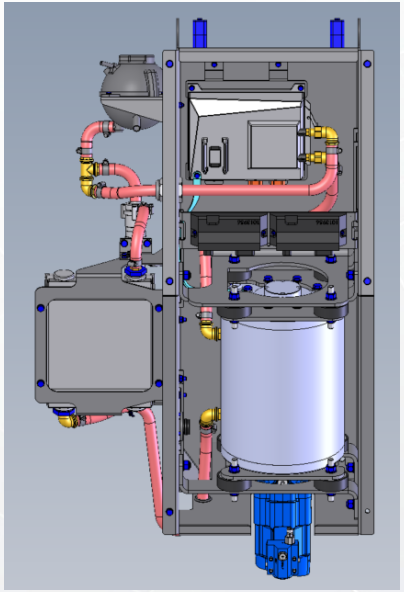
Why would I choose for a LION POWER Pro solution?

LION POWER PRO, the Geesinknorba total solution

Interface between body and Chassis

Consists of:

Hydraulic variable displacement pump
Electric Motor
Speed controller
Main controller
Cooling system



LION POWER PRO, the Geesinknorba total solution

What does A LION POWER PRO do?

- Provides body, tailgate and lift of oil and pressure
- Delivers only what is asked, from the tiniest demand up to heavy duty compaction
- Control system integrated in body
- Consumption of energy is around 1.4kWh per ton collected and compacted waste
- Therefore optimum flowrate and pressure
- Uses Power supply source of the Chassis.

Needs Lion Power Pro:

- HV connection 600- 800 VDC pre-charged

  Fuse min 63 Amps
  Normal CAN communication to chassis for exchange all relevant messages

- Suitable for hydrogen vehicles as well.

Minimum interference with chassis, systems well separated
Chassis independent solution

Full electric RCV's with Lion Power Pro

At this very moment we have five RCV's in service

• Riverside, UK (rental)	In service June2018
• BIR mini, Bergen Norway	in service September 2018
• Renovasjonen, Scandinavia	In service
• Ferrovial, Barcelona Spain	In service 2017
• Roteb Lease, Rotterdam	In service 28-03-2019

Vehicles to be put in service on short notice:

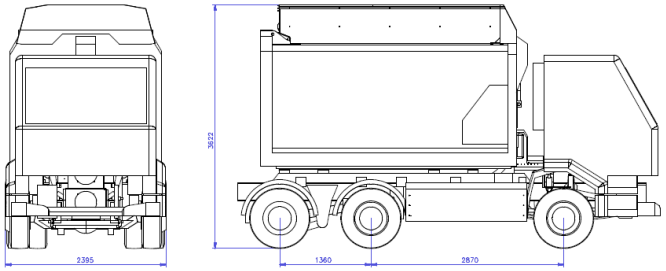
• Fiveways, UK (rental)	delivered
• E-Trucks, Amsterdam (2 units)	delivered
• DRM Switzerland, Iveco E-Force	in production
• LUND Sweden	Soon in production
• BIR N4	In production

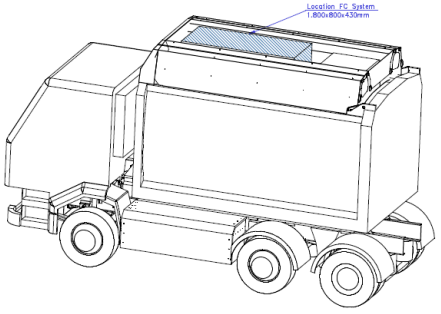
Full Electric RCV’s

Hydrogen trucks

First unit almost running in Groningen (E-trucks)

For Amsterdam a DAF LF FAG hydrogen truck is going to
Be build in combination with a Lion Power Pro





Geesinknorba cooperates with:

- Emoss
- E-Trucks
- E-Force One

Discussions regarding integration of the Lion Power Pro are going on at the moment with:

- Scania
- Volvo
- Renault
- Daf
- BYD
- Ginaf

- More to come

Full electric RCV's, average performance per day

Trade Waste	Manchester	City of London
Hours on shift	07:41	08:25
Tonnage collected	17.69	3.77
Containers lifted	229	120
Mileage	40	15
Battery utilisation kWh	158	64
Battery capacity used	79%	32%
Power costs £	15.80	6.40

Domestic Waste	Leeds City Council	Stockton Council
Hours on shift	6.75	08:25
Tonnage collected	24.62	3.77
Containers lifted	907	120
Mileage	80	15
Battery utilisation kWh	181	64
Battery capacity used	91%	32%
Power costs £	18.10	6.40

Consumption depends heavily on:
Type of driver
Type of terrain

Domestic Waste	Sheffield Veolia	Leeds City (2) Council
Hours on shift	7.00	7.17
Tonnage collected	21.00	22.92
Containers lifted	1055	1100
Mileage	55	66
Battery utilisation kWh	161	140
Battery capacity used	81%	70%
Power costs £	16.10	14.00

Manchester (4 wheel)

Hours on Shift	07:17
Tonnage Collected	17.34
Containers Lifted	252
Mileage	49
Battery Utilisation KWh	126
Battery Capacity Used	63%
Power Cost £	12.56

South Bucks (2 wheel)

Hours on Shift	6
Tonnage Collected	10
Containers Lifted	549
Mileage	77
Battery Utilisation KWh	157
Battery Capacity Used	79%
Power Cost £	15.70

BIR, delivered to Bergen, Norway

- The first delivery of in total 5 full electric trucks(13-09-2018)
- First test drive very successful
- Slopes of 15% very easy to overcome.
- Bumpy roads and streets no issue.
- Very narrow alleys and streets (see photo’s next slide)
- Very well received.
- BIR will keep and distribute records of performance and consumption.

BIR, delivered to Bergen, Norway

Geesinknorba on tour in Monaco!

Statistics electric garbage truck

	Outdoor temp			# of emptied bins/containers						Battery status % (battery capacity 120 kWh)				
Date	Morning	Afternoon	Rutebeskrivelse	140l	240l	400l	660l	Avfallstype	Kg	Start morge	In for lunch	Out after lu	End of day	Km driven
17.09.2018			Tom bil, varierte veier	0	0	0	0	ingen	0	100%	29%	29%	29%	137.5
18.09.2018			Testrute - "full bil"	2	0	0	52	restavfall	2230	100%	72%	92%	60%	60
19.09.2018			Langkjøring	0	0	0	0	ingen	0	100%	23%	44%	28%	172.3
20.09.2018			Ord rute, plast	26	12	6	10	plast	760	100%	43%	43%	43%	85
21.09.2018														
24.09.2018														
25.09.2018														
26.09.2018														
27.09.2018														
28.09.2018														
01.10.2018														
02.10.2018				46	17	8	5			100%				
03.10.2018				156	11	1	4			100%				
04.10.2018				97	59	5	12			100%				
05.10.2018				25	13	1	0			100%				
08.10.2018				19	20	13	11			100%				
09.10.2018				39	15	12	6	rest		100%	65%	80%	43%	71
10.10.2018				14	0	0	16	rest		100%	44%	49%	26%	127
11.10.2018				103	58	6	17	rest		100%	78%	95%	57%	75
12.10.2018				30	21	11	10	rest		100%	72%	89%	67%	67
15.10.2018				30	24	16	14	rest		100%	61%	68%	47%	65
16.10.2018				50	17	8	7	rest		100%	74%	88%	61%	62
17.10.2018				2	0		64	rest		100%	60%	60%	60%	67
18.10.2018				56	6	10	35	rest		100%	70%	70%	70%	32
19.10.2018			Ikke i drift											
22.10.2018				36	20	14	50	rest		100%	61%	77%	46%	84
23.10.2018	8	10		54	15	9	10	rest		100%	73%	90%	58%	75.9
24.10.2018	5	10		100	5	7	34	rest	3000	100%	45%	58%	27%	124.7
25.10.2018	8	12		77	62	7	58	rest	3700	100%	61%	82%	51%	85.2
26.10.2018	2	12		25	22	5	14	rest	1000	100%	65%	82%	55%	74.7
29.10.2018										100%				
30.10.2018										100%				
31.10.2018										100%				
11/01/2018				84	55	3	32	Rest		100%				
11/02/2018	9	12		42	13	1	17	Rest		100%	71%	93%	47%	87.8
11/05/2018	9	11		14	11	10	12	Rest	1300	100%			40%	74.3
11/06/2018	6	10		50	16	5	9	Rest	1280	100%	77%	93%	66%	56.1
11/07/2018	13	13		84	7	0	35	Rest	2780	100%	74%	90%	57%	79.2
11/08/2018	12	12		84	48	5	37	Rest	2780	100%	78%	93%	60%	59.8
11/09/2018	10	12		24	14	7	12	Rest	1180	100%	73%	85%	59%	62.9
11/12/2018	8	8		23	16	15	17	Rest	1720	100%	64%	80%	43%	74.5
11/13/2018	9	10		46	5	0	11	Rest	880	100%	73%	90%	76%	46.6
11/14/2018	9	10		123	5	3	39	Rest	3460	100%	62%	76%	48%	78.6
11/15/2018	10	10		81	52	5	33	Rest	2600	100%	69%	86%	58%	71.4
11/16/2018	11	11		17	9	0	8	Rest	600	100%			69%	39.7
11/19/2018	2	3		32	36	15	17	Rest	2220	100%	71%	85%	36%	86.2
11/20/2018	0	1		45	6	5	19	Rest	1560	100%	75%	95%	65%	63.1
11/21/2018	-2	4		96	6	8	17	Rest	2240	100%	62%	80%	45%	85.5
11/22/2018	-2	3		93	57	4	20	Rest	2610	100%	63%	79%	49%	72.3
11/23/2018	0	3		44	33	5	4	Rest	2160	100%	69%	83%	29%	94.2
11/26/2018	-4	-2		29	22	33	19	Rest	2580	100%	59%	75%	48%	61.4
27.11.2018	-2	-1		69	50	14	26	Rest	2880	100%	88%	97%	50%	56.2
11/28/2018	-4	1		87	5	8	36	Rest	3160	100%	54%	72%	43%	79.8
11/29/2018	8	8		86	56	12	11	Rest	2600	100%	74%	91%	59%	58.8
11/30/2018	8	10		42	46	19	10	Rest	2480	100%	78%	95%	59%	59.1
12/03/2018	7	8		24	16	13	16	Rest	1780	100%	70%	78%	47%	67
12/04/2018	4	2		61	54	21	24	Rest	3000	100%	77%	90%	55%	49.9
12/05/2018	0	2		96	6	4	33	Rest	3260	100%	56%	69%	3%	85
12/06/2018	2	2		111	56	7	14	Rest	3020	100%	67%	81%	46%	73.4
12/07/2018	6	6		28	42	15	32	Rest	1700	100%	75%	94%	79%	44
12/10/2018	3	5		24	18	10	25	Rest	2060	100%	71%	93%	52%	72.7

N4 body with Lion Power Pro

LI-ON Power Pro

Full Electric RCV

Geesinknorba Group

Our Full Electric RVC on it's way to our Customer in 2019

Chassis.	
Brand	DAF CF 75 Day Cab 4x2 26 Ton
Wheelbase	4 000mm
Body & lift.	
Geesink	Norba N4 22 m³ New L200
Payload.	10 000 kg
Drivline.	
Engine power	250 kW
Engine voltage	650 volt
Gearbox	Alison gearbox.
Battery pack	270 kWh Lithium- LION with Narada
cells	*400 kWh with Narada*
*cells & 4 600 WB **	Charger on board 44 kW
Range with max load	210 km (50%loaded) N.E.D.C cycle
Top Speed	85km/h
Charging Time(44kW)	
-100% capacity	5 hours
- 50% capacity	2,5 hours
Required Power Supply	3 phase, 400V, 63Amp

** Possible to get but need wheelbase of 4 600mm*

The 3rd unit for BIR in Bergen, Norway 2019

Geesinknorba is ready for the future

Check our dedicated website:
https://www.geesinknorba.com/electric-driving/

Thank you for your attention