

# WELCOME!

## AGRICULTURAL ROBOTICS WEBINAR



- ▶ **Presented by VARTA:** Thursday May 7<sup>th</sup> 2020 at 1:30pm CET
- ▶ We will begin in a few moments. We encourage you to use a separate phone to dial-in for the audio, especially in case any audio issues are experienced and use your computer for the presentation material only.
- ▶ Participants are automatically muted but may ask questions via the control panel. You can also chat via the control panel if you have an issue.
- ▶ We will handle any questions at the end but please feel free to submit questions at any time via your webinar control panel

# WELCOME! AGRICULTURAL ROBOTICS WEBINAR



# Agricultural Robotics: An Overview



- ▶ **What factors are driving this developing market?**
  - ▶ Cost savings for repetitive tasks (i.e. labour)
  - ▶ Improved yield from more accurate or efficient farming
  - ▶ Entirely new data-driven farming techniques
- ▶ **Which applications are emerging?**
  - ▶ A brief roundup of some of the solutions in the market now
- ▶ **The Battery Challenge**
  - ▶ Custom vs Standard
  - ▶ Energy Demands, Environment, Voltage
- ▶ **The Charging Challenge**
  - ▶ Mobile Robots all the same, or some need longer run-times?



# Agricultural Robotics: Development Factors



## ▶ Cost savings

- ▶ Controlled, repeatable tasks
- ▶ Wide area coverage
- ▶ Reduced labour cost

## ▶ Think

- ▶ Seeding, Weeding, Picking/Harvesting and Feeding
- ▶ Barn animal stimulation or cleaning/removal of waste



# Agricultural Robotics: Development Factors



- ▶ **Improved yield/output**
  - ▶ Improved farming accuracy from robot-controlled devices
  - ▶ Higher productivity for low to no additional marginal cost
  - ▶ Greater yield from well-attended crops
  - ▶ Improved conditions for animals = reduction in costs to fight disease
- ▶ **Think**
  - ▶ Better or reduced crop spraying
  - ▶ Stimulation of poultry activity aids growth

# Agricultural Robotics: Development Factors



- ▶ **New farming techniques**
  - ▶ Continuous and **fully accurate** data-collection and utilization
  - ▶ Computer-controlled decision making, based on received information
  - ▶ Step-change improvement to wellbeing of crops or farm animals
- ▶ **Think**
  - ▶ Data-driven picking schedule helps to achieve the best price and minimize losses



# Agricultural Robotics: Example Applications



## ▶ Sprayers

- ▶ Feeding and pesticide application for crops

## ▶ Weeders

- ▶ Keeping the earth clear round the clock

## ▶ Animal-Care

- ▶ Cattle Feeders
- ▶ Waste management
- ▶ Poultry stimulation



# Agricultural Robotics: Example Applications



- ▶ **Tractor replacement**
  - ▶ Self-driving tractors
  - ▶ Capable of various tasks with different attachments
- ▶ **Scouting / Data Mining**
  - ▶ Drones and scouts
  - ▶ Evaluate crops according to computer-learning models
  - ▶ Improve care and yield significantly





# Agricultural Battery Challenge: A Few Questions



- ▶ What type of Mobile Robotics?
  - ▶ Large, Medium, or Small?
  - ▶ Usage profile?
- ▶ Motor Voltage Requirements?
  - ▶ Higher is more efficient, since motor currents are lower.
- ▶ How often is it Charged?
  - ▶ During operation? (During the day?)
    - ▶ Will Battery be replaced with a full one or charged briefly?
  - ▶ Overnight only?
- ▶ Capacity needs – fixed or expandable?
  - ▶ Mobile Robots all the same, or some need longer run-times?

# What Type of Mobile Robotics?



## Large:

### Tractor Replacement



- ▶ Higher voltages
- ▶ 200 to 2000 Ah
- ▶ Diesel today
- ▶ Flexible usage

## Medium:

### Scouts, Weeders, Feeders, Animal Applications



- ▶ 24V, 36V, 48V
- ▶ 10 to 100Ah
- ▶ Mostly Li-Ion
- ▶ Battery embedded
- ▶ Dedicated usage profile

## Small:

### Drones and Scouts



- ▶ 12V, 24V
- ▶ 5 to 50Ah
- ▶ Majority Li-Ion
- ▶ Embedded or removable
- ▶ Variety of usage models

# What Type of Mobile Robotics?



Large:	Medium:	Small:
Tractor Replacement	Scouts, Weeders, Feeders, Animal Applications	Drones and Scouts
<b>Custom Battery Solutions</b>	<b>Standard Battery Solutions</b>	
<b>System Solution (Battery, Charger, Accessories)</b>		
<ul style="list-style-type: none"><li>▶ Higher voltages</li><li>▶ 200 to 2000 Ah</li><li>▶ Diesel today</li><li>▶ Flexible usage</li></ul>	<ul style="list-style-type: none"><li>▶ 24V, 36V, 48V</li><li>▶ 10 to 100Ah</li><li>▶ Mostly Li-Ion</li><li>▶ Battery embedded</li><li>▶ Dedicated usage profile</li></ul>	<ul style="list-style-type: none"><li>▶ 12V, 24V</li><li>▶ 5 to 50Ah</li><li>▶ Majority Li-Ion</li><li>▶ Embedded or removable</li><li>▶ Variety of usage models</li></ul>

# Motor Voltage Requirements



- ▶ Higher is Better for Motors
  - ▶ Higher Voltage Motors are More Efficient
  - ▶ Lower Operating Currents
  - ▶ Lower Operating Temperatures (Why?  $\text{Power \& Heat} = I^2R$ )



**But** ‘stacking’ Batteries risks imbalance. And will the Battery be too BIG?

- ▶ Fixed Voltage Systems avoid Battery imbalance (it’s handled in the design)
- ▶ Li-Ion up to 60V has low weight

**Bigger** within limits: 48V Nominal is highest without added handling concerns

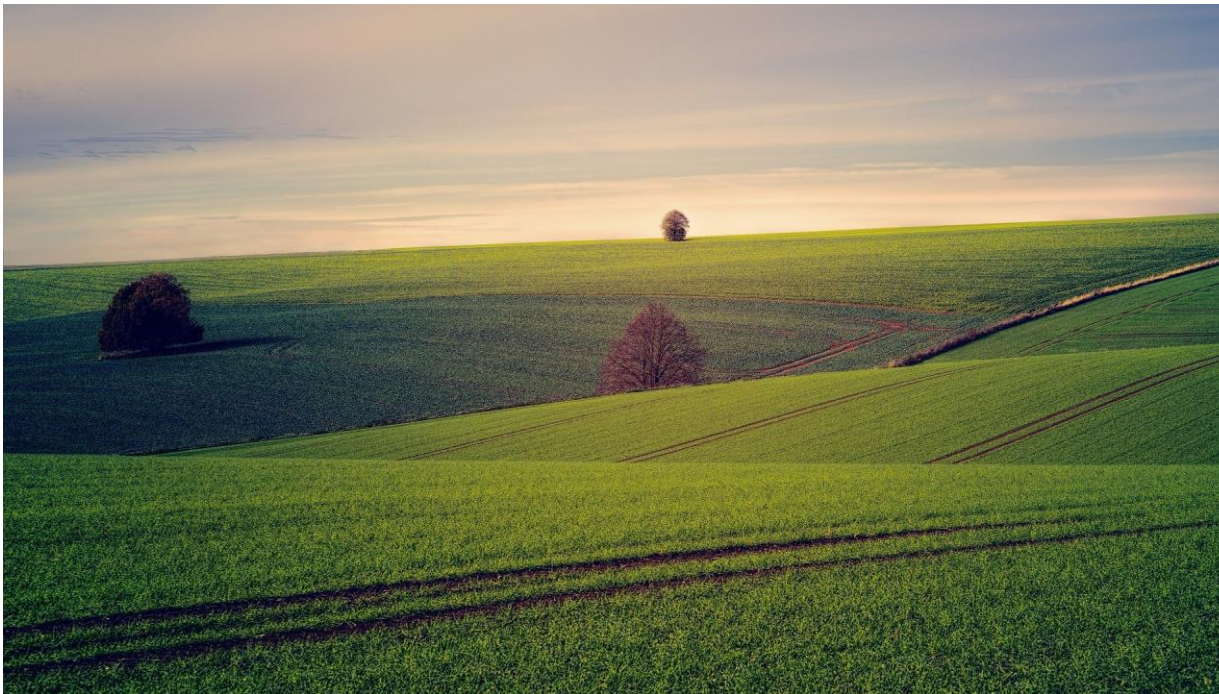
- ▶ “48V” is typically 50-52V nominal and up to 59V for Charging
- ▶ Batteries >60V have additional safety handling precautions

- ▶ Fast Charge Options: Some Lithium Battery chemistries like it, others do not!
- ▶ How often is it Charged?
  - ▶ During operation? (During the day?)
    - ▶ If Charging during Operating time then “usage up-time” is decreased
  - ▶ Will Battery be replaced with a full one or charged briefly?
    - ▶ “Opportunity” charging during breaks vs. Battery “swap-out”
  - ▶ Overnight only?
    - ▶ Are there enough Chargers? Added cost if need 1:1 Charger to Robot
- ▶ Wireless Charging: A nice option, but may require a larger charger due to losses.
- ▶ Regenerative Charging: Can the Mobile Robot put energy back to the Battery?

# Charging Considerations



- ▶ Location: Can the robot get access to energy to be recharged or (even better) recharge itself?

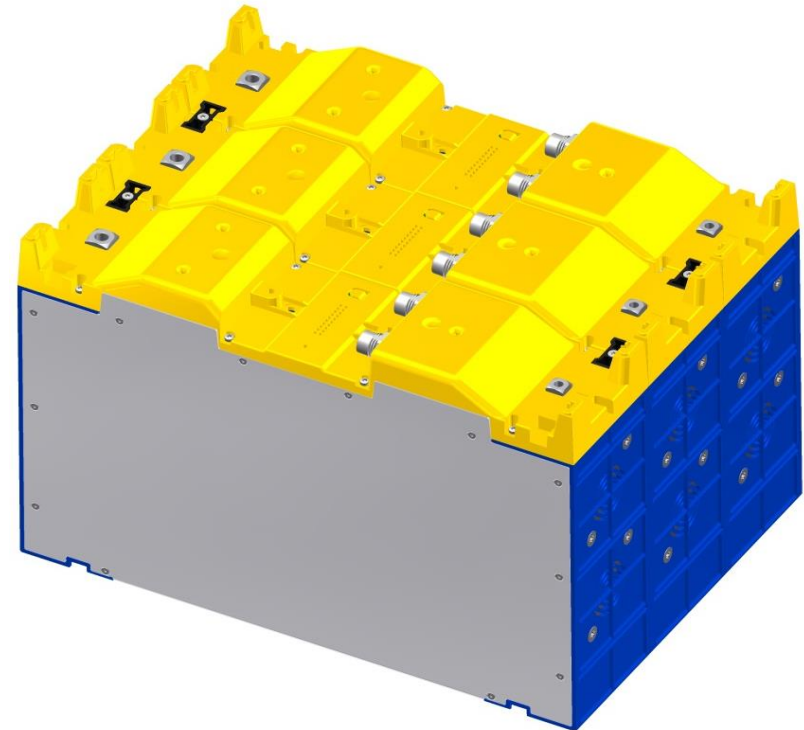
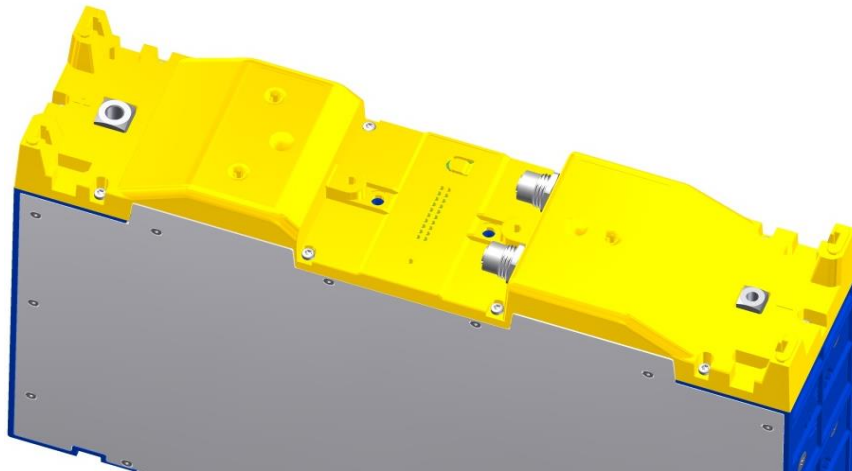


# Capacity Needs

- ▶ Capacity needs – fixed or expandable?
  - ▶ All the same, or a mixed fleet with some need longer run-times?
    - ▶ Ability to easily add capacity: “Parallel-ing” same voltage Batteries

From one...

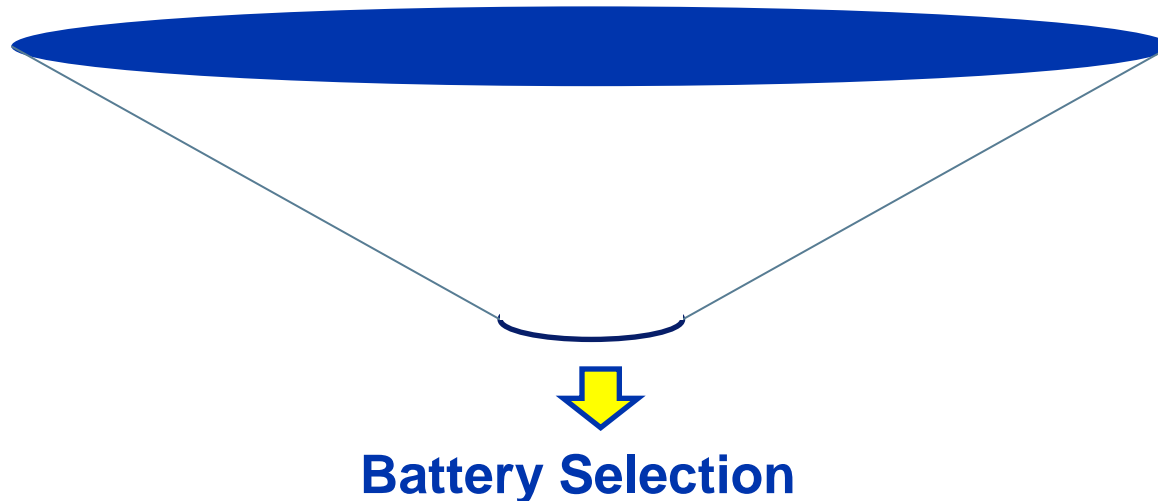
to many...



# Summary: Factors in Battery Selection



- ▶ What type of Mobile Robotics? Small – Medium – Large
- ▶ Motor Voltage Requirements? 12V, 24V, 36V, 48V
- ▶ How and where is it Charged? Charge capability
- ▶ Capacity needs – fixed or expandable? Single or Expandable





# Mobile Robotics Batteries by VARTA



## MODULAR



## STANDALONE



	Easy Block	Easy Blade	Easy Stack	Easy Slice
12 V	-	-	161 Ah	80.5 Ah
24 V	22.8 Ah	64 Ah	80 Ah	40 Ah
36 V	-	-	47 Ah	23.5 Ah
48 V	11.4 Ah	32 Ah	40 Ah	20 Ah

**Connect up to 25 in Parallel  
No Master BMS Needed**

**Easily Removeable for  
Swappable Battery Options**

# Shared Features of EasyBlock & EasyBlade



- ▶ Modular design for parallel connection up to 25 modules
- ▶ Fast charging to 80% within 1 hour, fully charged in <3 hours
- ▶ Allows Re-generative Charging
- ▶ Automatic Master-Slave Identification: One Battery controls the whole system
- ▶ Lightweight, compact modular designs with stacking and locking features for robust mechanical horizontal and vertical stacking
- ▶ Zero maintenance or service requirements from the user
- ▶ Balanced energy density, power and lifetime performance.
- ▶ Integrated communications – CAN Bus (CANopen)
- ▶ Multi-level safety integrated into each pack
- ▶ Comprehensive design-in resources

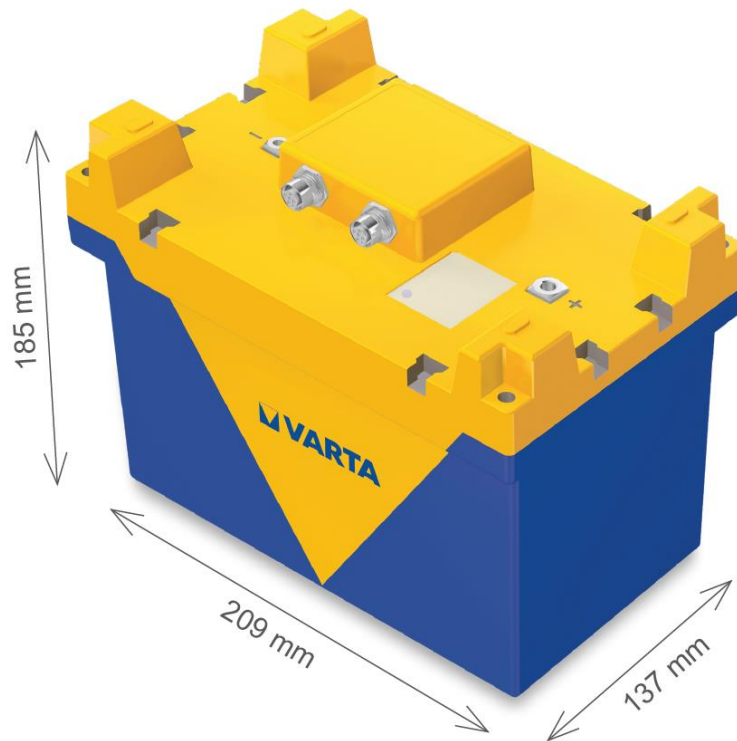


# VARTA Easy Blade Modular



- ▶ High Energy Li-Ion Technology
- ▶ Available in 24V and 48V versions
- ▶ Active Cooling for improved cycle life performance
- ▶ Zero Maintenance during life cycle
- ▶ Up to 64Ah per module (24V)
- ▶ 1,000 cycles to 80%
- ▶ UN38.3 & IEC-62133-2 Certifications
- ▶ Connect up to 25 modules in parallel for more than 41kWh total system energy!

# VARTA Easy Block Modular



- ▶ Long Life Li-Ion Technology
- ▶ Available in 24V and 48V versions
- ▶ 4,000 cycles to 80%
- ▶ Zero Maintenance during life cycle
- ▶ Up to 22.8Ah per module (24V)
- ▶ Connect up to 25 modules in parallel for more than 14kWh total system energy!

# VARTA Easy Stack Standalone



- ▶ > 2kWh High Energy Li-Ion Technology
- ▶ Available in 12V, 24V, 36V, and 48V options
- ▶ LED State of Charge Indicator
- ▶ Zero Maintenance during life cycle
- ▶ Up to 161Ah per module
- ▶ 1,000 cycles to 80%
- ▶ Easy Exchange with standard connector and lifting/carrying handle

# VARTA Easy Slice Standalone



- ▶ > 1kWh High Energy Li-Ion Technology
- ▶ Available in 12V, 24V, 36V, and 48V options
- ▶ LED State of Charge Indicator
- ▶ Zero Maintenance during life cycle
- ▶ Up to 80.5 Ah per module
- ▶ 1,000 cycles to 80%
- ▶ Easy Exchange with standard connector and lifting/carrying handle

# Design-In Resources




► Datasheets for quick reference and product selection

► Technical Handbook containing detailed info and set-up guidance

► [www.varta-storage.com/asb](http://www.varta-storage.com/asb)

### Easy Blade 48

51.8 V | 32 Ah nominal | 1,657 Wh | VKB: 56654 799 097



**GENERAL (Battery with safety circuit and plastic / metal construction)**

Size (l x w x h) in mm	200 x 330 x 80
General	LiIbm-Ko-Mn-Al-Manganese-Co-Iso-Organic with SBR
Communication	CAN Bus (CanOpen)
Weight	Approx. 10 kg

\* Illustration only

**ELECTRICAL SPECIFICATION**

Power connection	Negative terminal: M5 (old) screw type, rated female terminal Positive terminal: M5 (high) screw type, rated female terminal
CAN BUS connection	Type: 24 (new) M12-S, plug, female socket Mating style: screw thread Coding: A Model: Tyco Electronics T411000001-000 or similar
Nominal voltage	51.8 V
Nominal capacity (0.2 C; 2.90 V discharge)	32 Ah
Nominal energy	1,657 Wh
Charging method	Constant current + constant voltage
Max. charge voltage	58.5 V
Rec. charge voltage	55.5 V
Max. charge current	31 A
Rec. charge current	10.3 A
Rec. charge cut off	Current < 1.0 A
Rec. discharge cut off	42 V
Max. continuous discharge current	60 A
Rec. discharge current	15.5 A
Exp. cycle life at (0.3 C / 0.5 C), 22 °C ± 2 °C	> 80 % of initial capacity at 1,000 cycles

**CELL & BATTERY PROTECTION**

Safety function	Overheat
Fuse	100 A

**ENVIRONMENTAL CONDITIONS**

Charge	0 °C to +20 °C
Discharge	-20 °C to +20 °C
Storage	1 to 3 m
Life	1 year
Humidity	25 to 85 %
IP rating	IP50, no

**SAFETY CERTIFICATIONS**

Please follow VARTA handling and safety measures for the cell used in a UL recognized component according to IEC 60947-2. This battery meets the requirements of battery directives. This battery is certified according to IEC60947-2:2017.


**FEATURES**

- Active cooling for improved lifetime.
- Easily connected up to 25 modules in parallel for higher capacity.
- Housing with locking feature for easy attachment to edge.
- No external battery management needed. Automatic read.
- Zero maintenance, zero emissions.
- Limited 2 year warranty.

Minimum order quantity: 200 pcs / Order multiples: 50 pcs

### Easy Block 48

51.2 V | 11.4 Ah nominal | 583 Wh | VKB: 56650 764 098



**GENERAL (Battery with safety circuit and plastic / metal construction)**

Size (l x w x h) in mm	121 x 200 x 107 x 80
General	LiIbm-Ko-Mn-Al-Manganese-Co-Iso-Organic with SBR
Communication	CAN Bus (CanOpen)
Weight	Approx. 10 kg

**Electrical Specification**

Power connection	Negative terminal: M5 (old) screw type, rated female terminal Positive terminal: M5 (high) screw type, rated female terminal
CAN BUS connection	Type: 24 (new) M12-S, plug, female socket Mating style: screw thread Coding: A Model: Tyco Electronics T411000001-000 or similar
Nominal voltage	51.2 V
Nominal capacity (0.2 C; 2.90 V discharge)	11.4 Ah
Nominal energy	583 Wh
Charging method	Constant current + constant voltage
Max. charge voltage	58.5 V
Rec. charge voltage	55.5 V
Max. charge current	31 A
Rec. charge current	10.3 A
Rec. charge cut off	Current < 1.0 A
Rec. discharge cut off	42 V
Max. continuous discharge current	60 A
Rec. discharge current	15.5 A
Exp. cycle life at (0.3 C / 0.5 C), 22 °C ± 2 °C	> 80 % of initial capacity at 1,000 cycles

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Safety function	Overheat
Fuse	100 A

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Charge	0 °C to +20 °C
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- Limited 2 year warranty.

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VARTA Storage – VARTA Microbattery

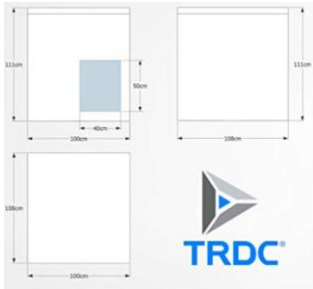
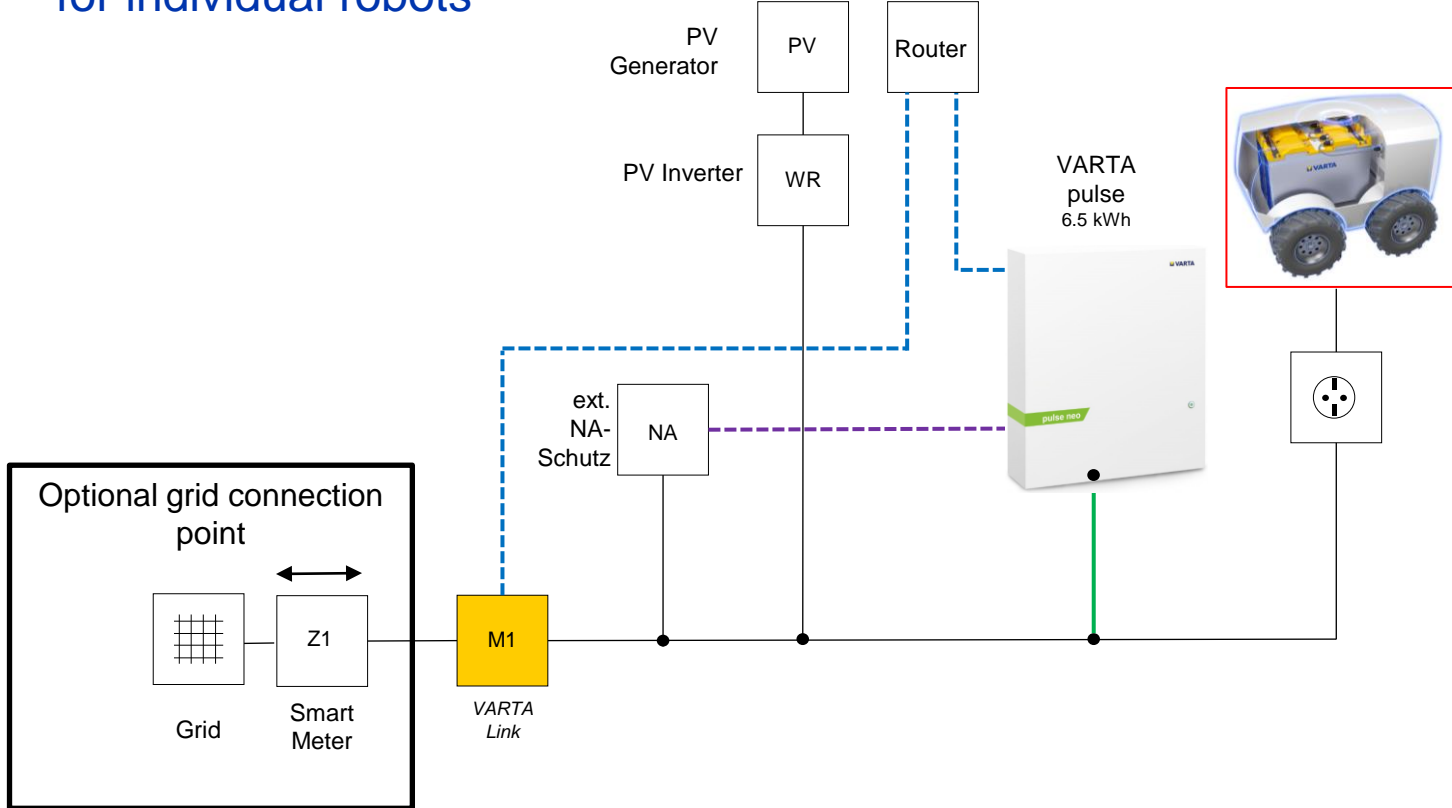
Our brands;

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# Charging Solutions for Agricultural Robotics by VARTA



## ▶ Small Charging Station for individual robots

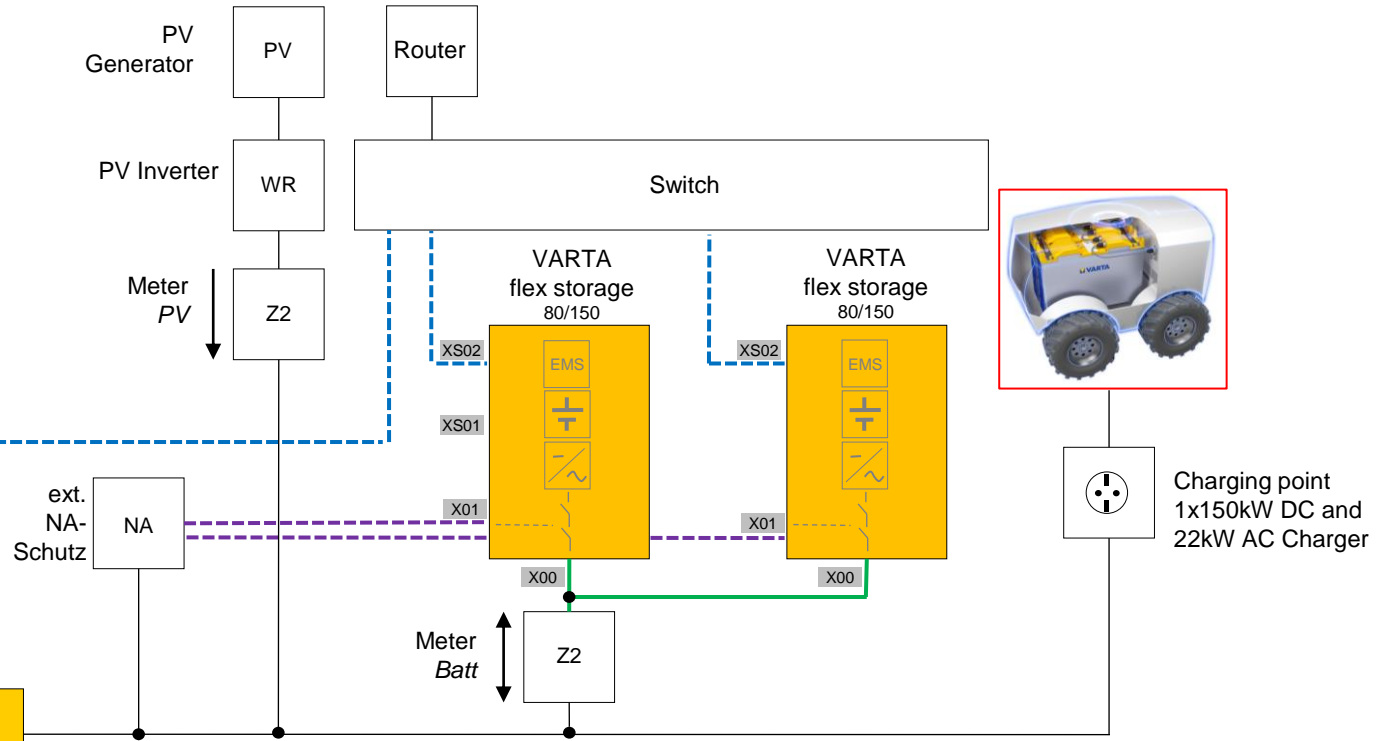
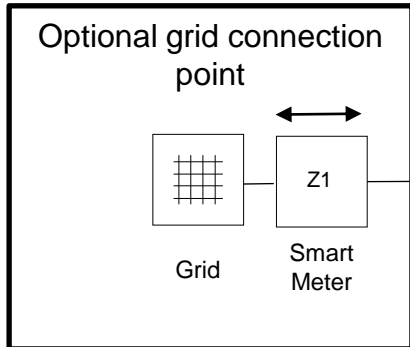




# Charging Solutions for Agricultural Robotics by VARTA



► Large scale solar container



# Solar Container Components



## ▶ Container

- ▶ 1x 20ft container
- ▶ Air conditioning
- ▶ 150 kW DC-charger
- ▶ 22 kW AC-charger

## ▶ Battery storage system

- ▶ 2x VARTA flex storage E 80/150
- ▶ System power 160 kW
- ▶ Capacity 300 kWh
- ▶ Integrated EMS
- ▶ Integrated BMS

## ▶ Photovoltaic

- ▶ 78 Mainstream PV-panels
- ▶ Output Power 23.4 kWp



VARTA AG

MICROBATTERIES & SOLUTIONS

HOUSEHOLD BATTERIES

Healthcare	Entertainment	Solutions
		

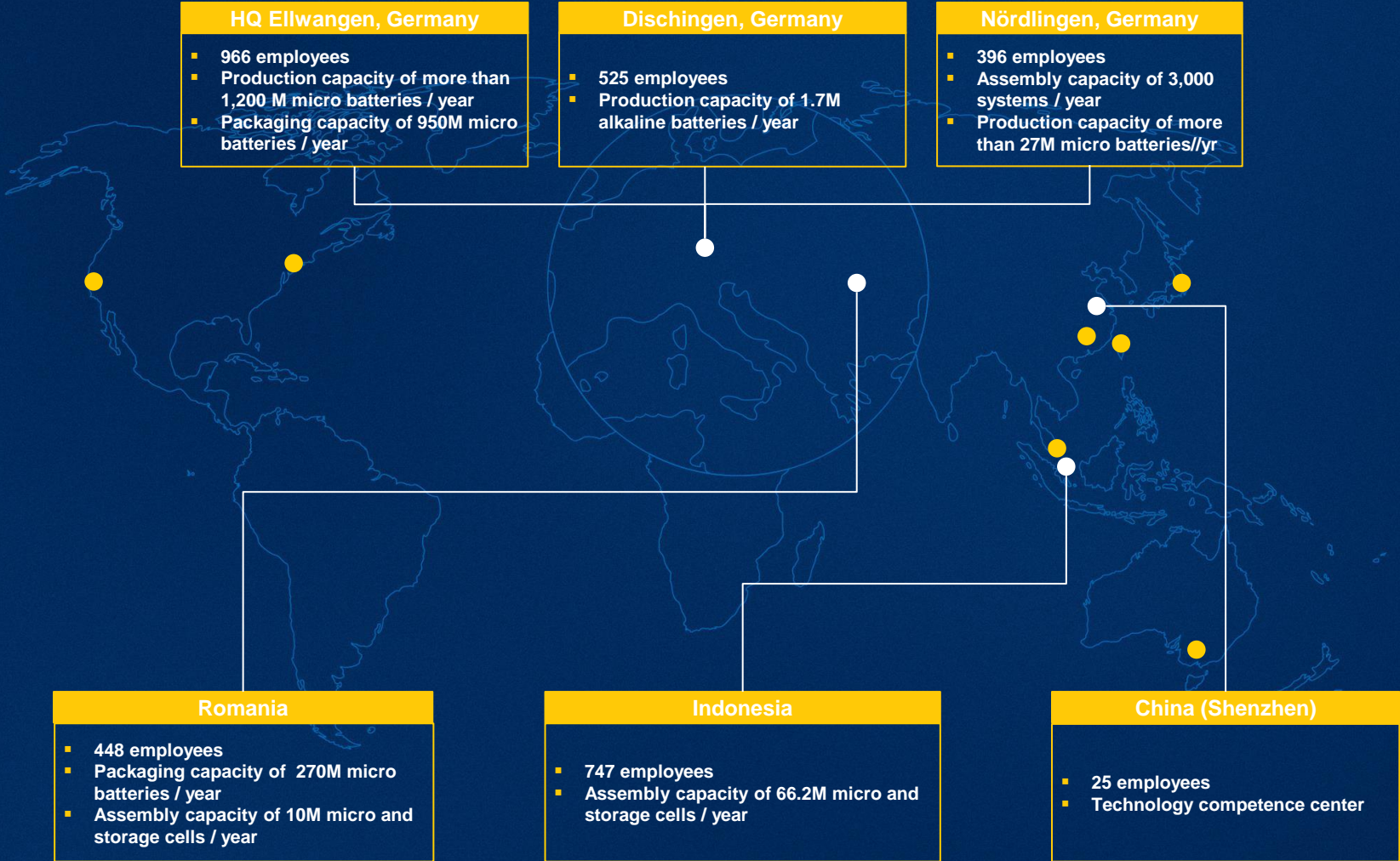
Consumer Batteries	Energy Storage
	

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[www.VARTA-Storage.com](http://www.VARTA-Storage.com)

**Consumer Coin & Cylindrical Cells;  
Home Energy Storage**  
[www.VARTA-Consumer.com](http://www.VARTA-Consumer.com)

# Global Footprint



● Production  
● Sales Office

# Batteries for Mobile Robotics

[www.varta-storage.com/asb](http://www.varta-storage.com/asb)



## MODULAR



## STANDALONE



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24 V	22.8 Ah	64 Ah	80 Ah	40 Ah
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48 V	11.4 Ah	32 Ah	40 Ah	20 Ah

**Connect up to 25 in Parallel  
No Master BMS Needed**

**Easily Removeable for  
Swappable Battery Options**

CHOOSE WISELY – CHOOSE VARTA

**THANK YOU!**

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Find more information here: [www.varta-storage.com/asb](http://www.varta-storage.com/asb)

Or email [asb@varta-storage.com](mailto:asb@varta-storage.com)

# Start Today!



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