Advanced Logistics Transport System (ALTRaS) Research Project

○Nozomu Hatakeyama, Akira Miyamoto, Hidetoshi Matsuki, Takahiro Suzuki and Fumihiko Hasegawa

New Industry Creation Hatchery Center (NICHe), Tohoku University

“Sendai” in Tohoku Region

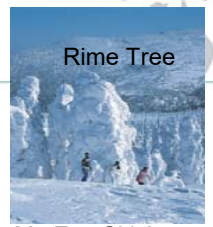
* Nature 442 (2006) 714

Vehicle Technology International Conference, October 1-2, 2019.
Winnipeg, Manitoba, Canada.


Sendai Castle


Matsushima Bay


Naruko Gorge



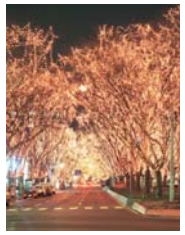
Mt. Zao Ski Area


Shopping Arcade


Aoba Street


Tanabata Festival


Music Festivals


Pageant of Starlight


Sushi


Oyster


Hot Springs

About NICHe

Partnership between Industry and University

Established in 1998

Planning & Management of Collaborative Research Projects to Provide Solutions for Industry & Society

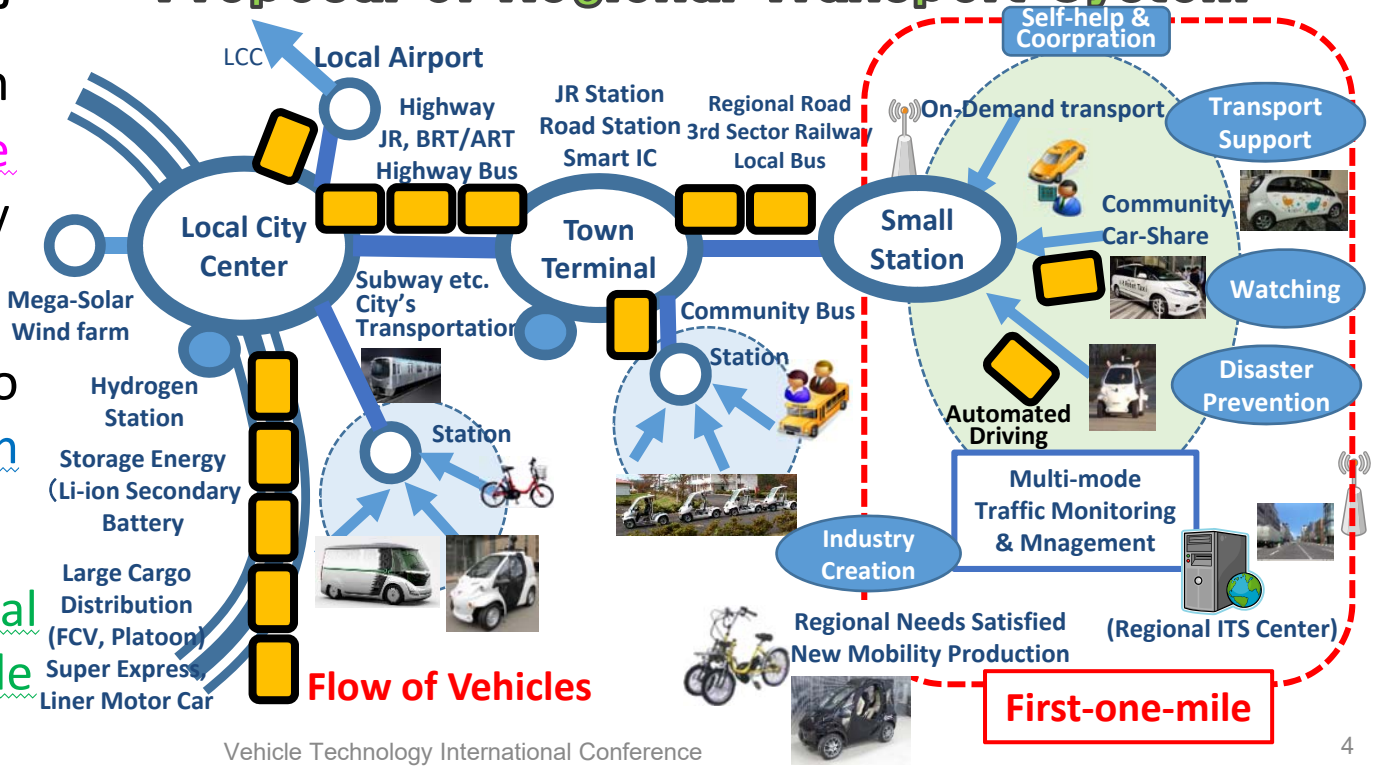
20 Research Projects
JPY 2.9B Budget with 232 staff, including 156 Researchers,
as of Oct. 1st, 2013

NICHe Guideline for Projects

1. World Leading Research
2. Predetermined Period, 3 to 5 Years Typical
3. Needs Oriented & Large-Sized Project with Industry & Government
4. External Funding

■Subject of Project: Proposal of Regional Transport System

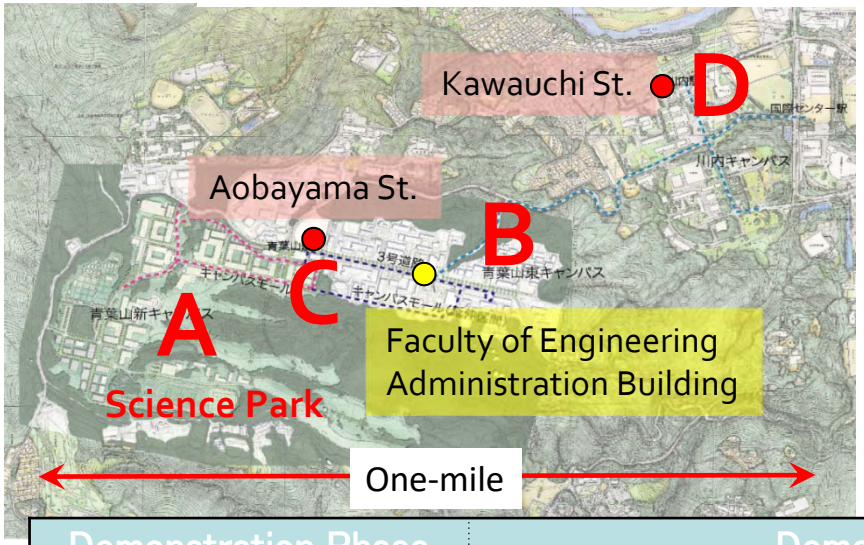
- Implementation of Near-Future Traffic System by Applying Ward
- Contribution to Aging, Population Drain Society
- Increase of Local Industry and Trade

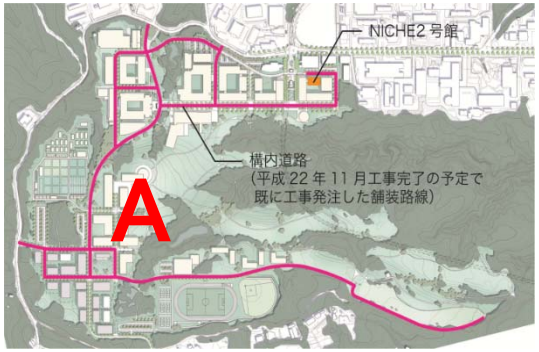


Aobayama New Campus & Subway

Up to 10 thousands Commuter, Only One Subway Station

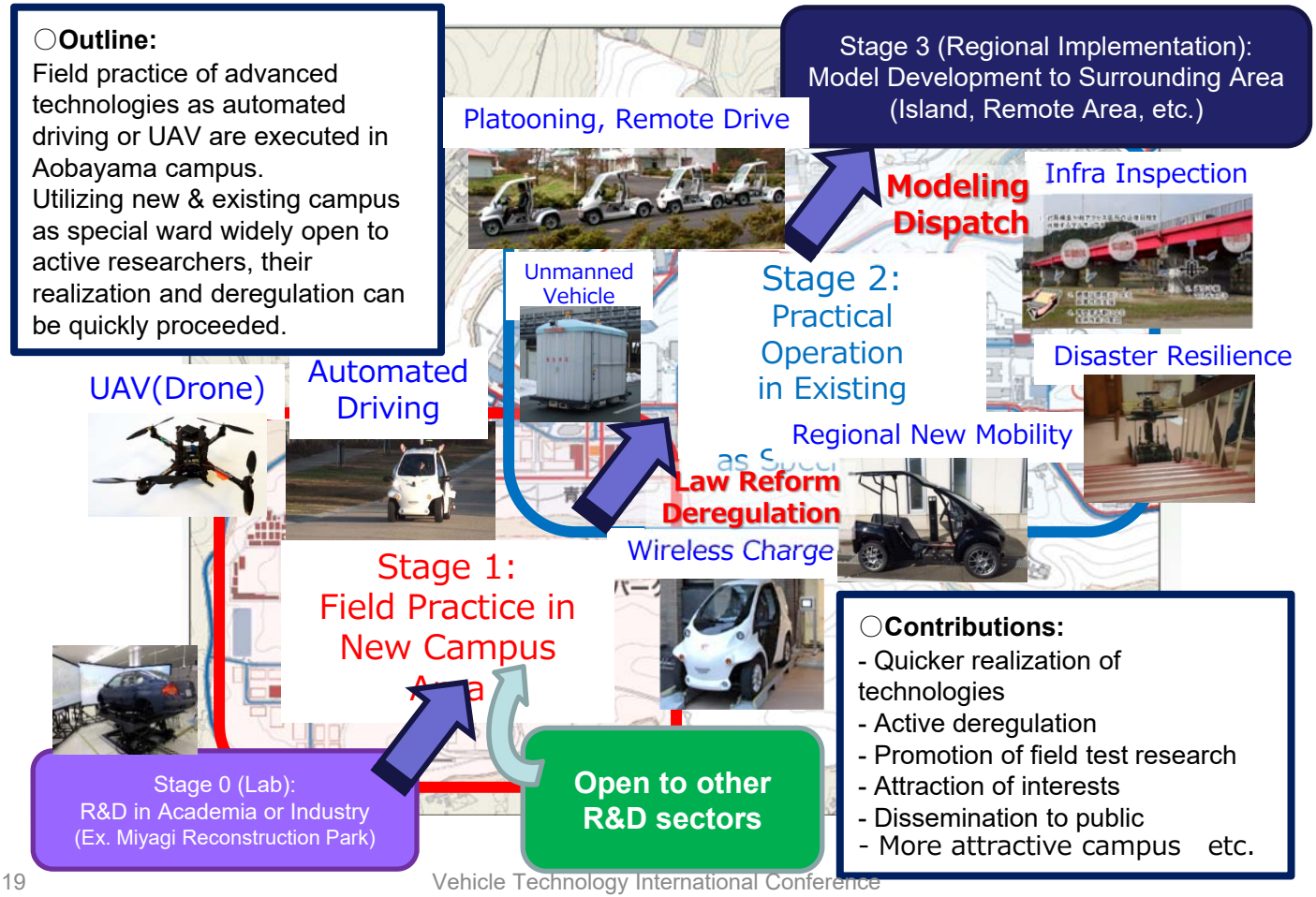
No Feeder Transportation in New & Existing Aobayama Campus



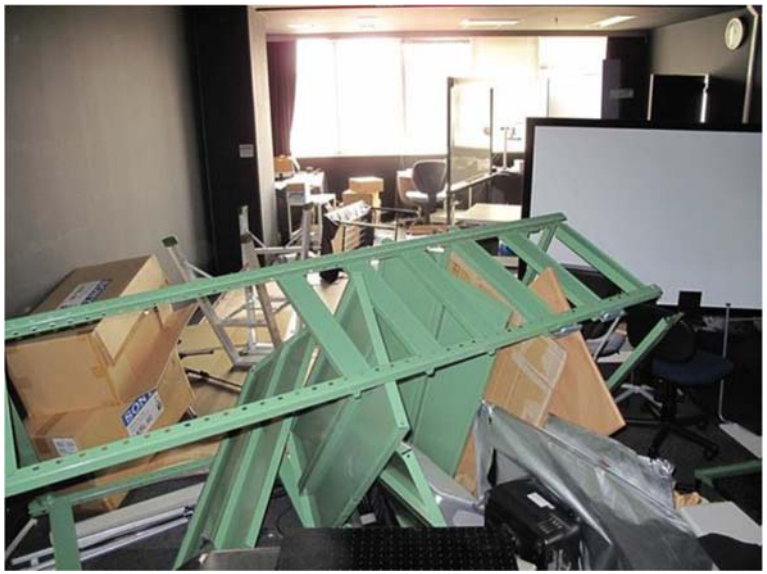


Demonstration Phase	Demonstration Area
2013FY ~ Vehicle Development	Campus Mall Zone, Aobayama New Campus (A)
Pilot Study 1	Aobayama New Campus (A) & East Zone (B) Determine the best way to the Mobility in Aobayama
Pilot Study 2	Aobayama Station (C), Kawauchi Station (D) and Other Campuses

Advanced Technology Field Practice Special Ward :
"Creation of Aobayama Campus Next-Generation Advanced Mobility System Practice Field"
=> Authorized as "Sendai Social Innovation Creation Special Ward" (2015)



Next Day of Big Earthquake on March 11, 2011



Laboratory

Neighborhood of university

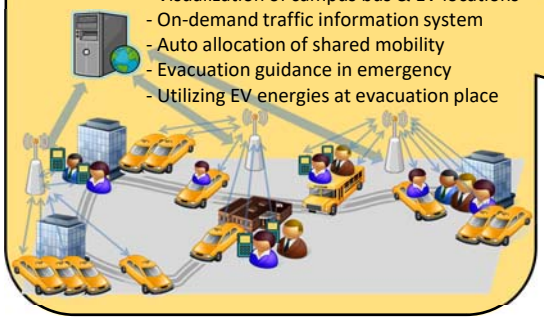
Resilience of local industries was required

New Industry Creation Hatchery Center (NICHe), Tohoku University

For Social Contribution

Aobayama Campus Field Experiment

- Visualization of campus bus & EV locations
- On-demand traffic information system
- Auto allocation of shared mobility
- Evacuation guidance in emergency
- Utilizing EV energies at evacuation place



Social Implementation to Tohoku Disaster Area

- Sustainable transport system supplementing each other
- Resilient multi-mode system for dual-use (normal/disaster)
- Advanced technologies to revitalize local community
- Distribute to coastal, mountainous, island & remote resions

Advanced Logistics Transport System (ALTRaS) Research Project

Prototype Evaluation Base for Next-Generation Vehicles

Miyagi Reconstruction Park
NICHe TAGAJYO BASE
In the Sony Corporation Sendai Technology Center

- Early operation restarting of the suffered companies
- Creation of new industry and employments by advanced technologies

Cross-cutting Integration for Advanced Technology Development

- EV Bus - Wireless Charging
- In-Wheel Motor
- Head-Up Display
- Omnidirectional Camera

- Micro EV
- Autonomous Vehicle
- Lithium-ion Capacitor EV
- Dual-Mode EV (for emergency)

- Driving Simulator
- Traffic Simulation
- Virtual Space
- Driver Sensing

Region-based Collaboration of Industry-Academia-Government

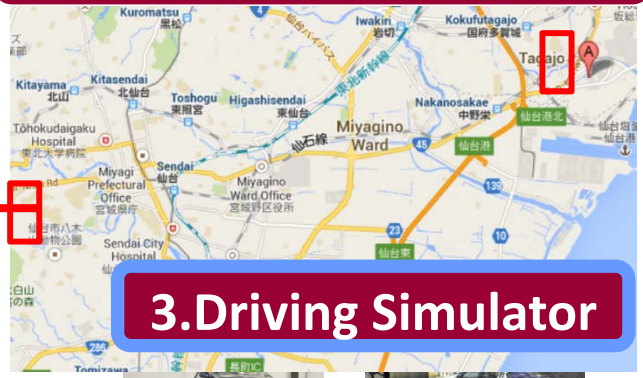
- Toyota Motor East Japan, Inc.
  Outdoor Un-manned Vehicle Next-Generation Distribution
- Kudo Electronics Corporation
  Motor, Power Electronics
- Hikichiseiko Co.,Ltd.
  Wireless Charging Station
- Murakami Co.,Ltd.
  EV Design & Manufacturing

under collaboration with Ministries, Prefectures, Cities & Towns

Advanced Logistics Transport System (ALTRaS) Research Project

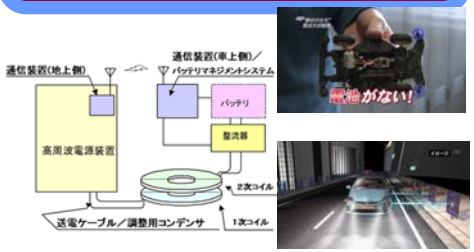
Demonstration in Aobayama

Miyagi Reconstruction Park



3.Driving Simulator

1.Contactless Power Transmission



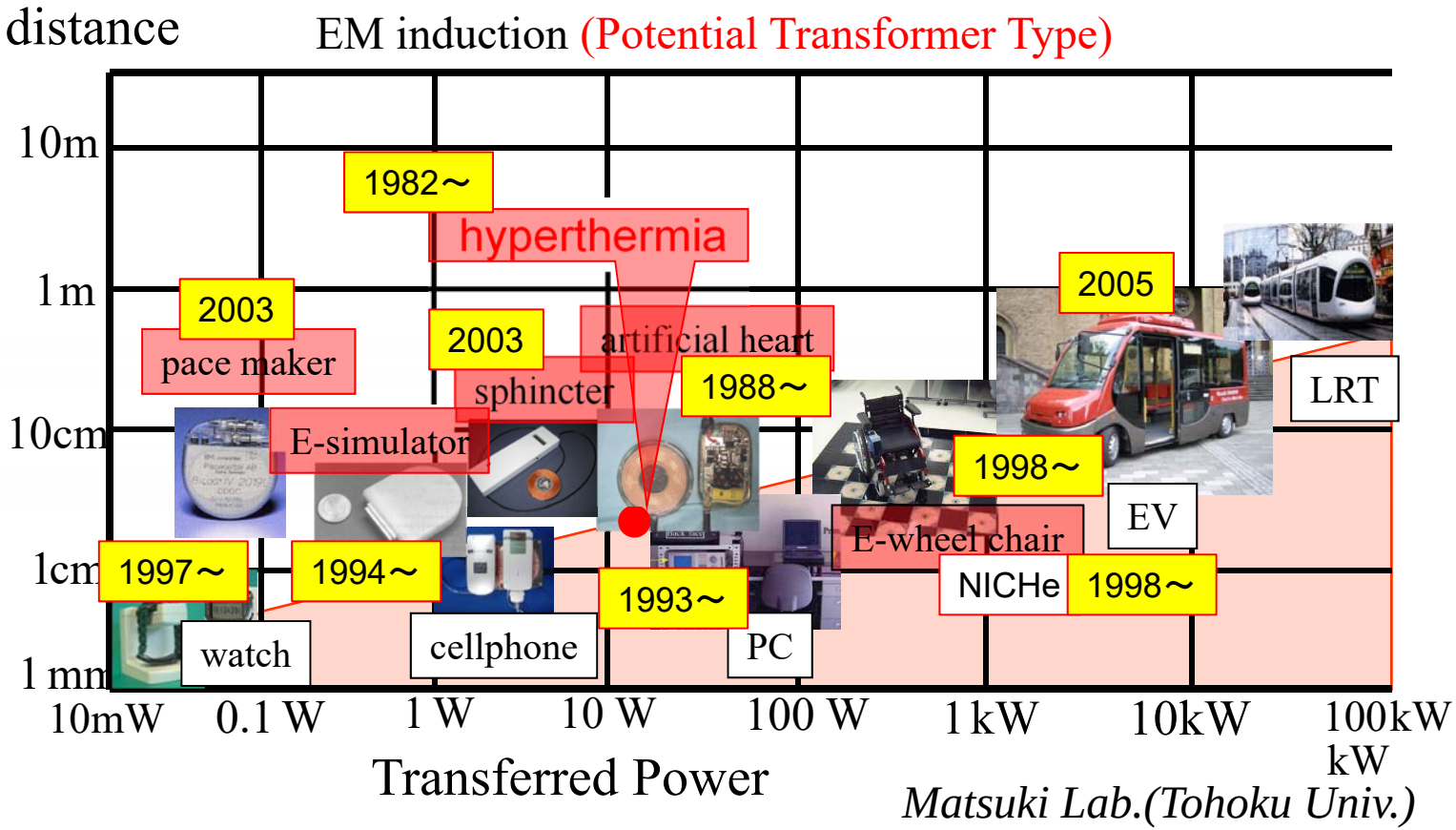
2.Robotics

Autonomous Driving

4.EV: Passenger, Transit Bus, Bike

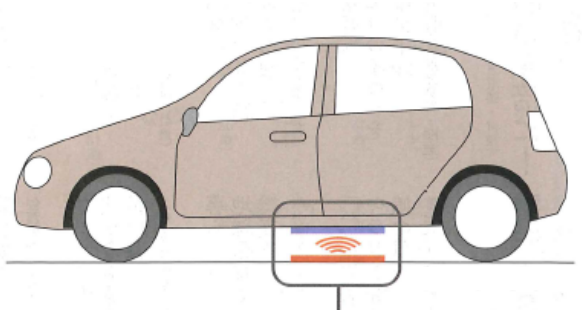
5.Self-made Li-ion Battery

Development of Wireless Power Transfer

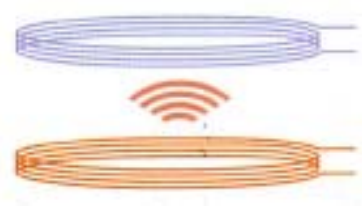


Demonstration experiment of the wireless charge

Outline of Wireless Charge



Electricity transmission by
the electromagnetic induction phenomenon



Receiver coil

Transmission coil

High-Performance Wireless Charge System

EV

Key Technology of ATRaS

Wireless Charge

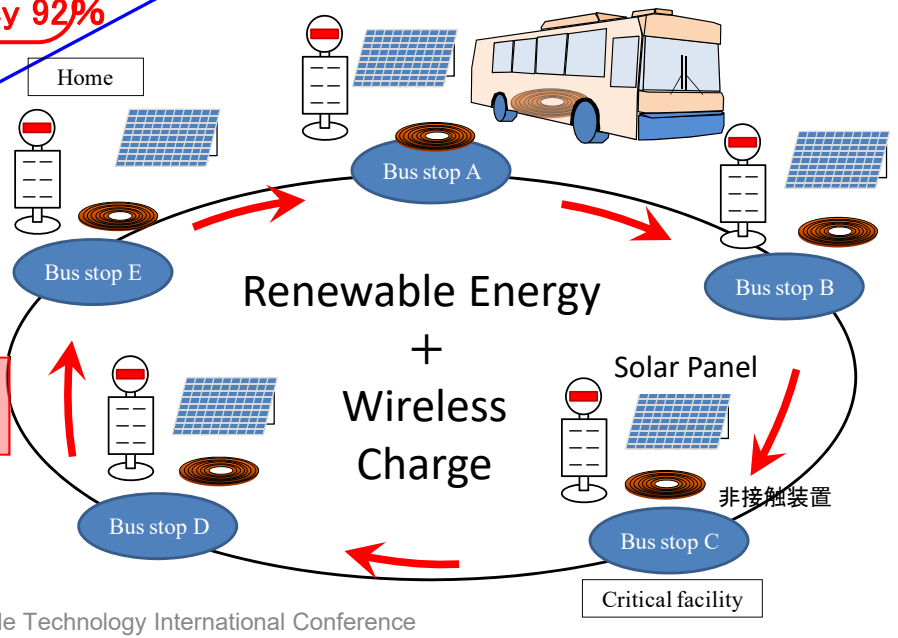
Power 30 kW
Efficiency 92%

Choko-Choko-Charging

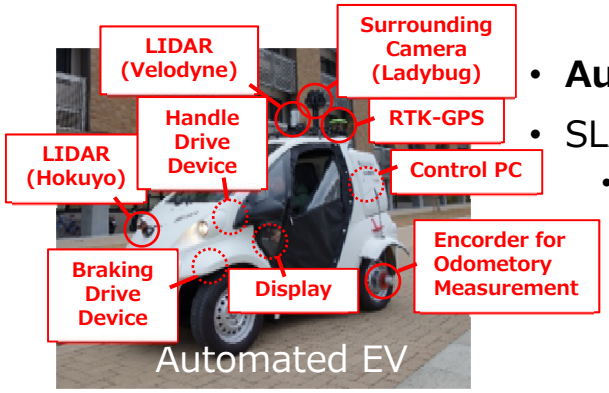
Hard System (Running)

Stop and Charge

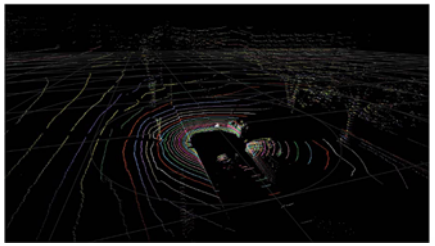
Frequently Charge
→ Wireless



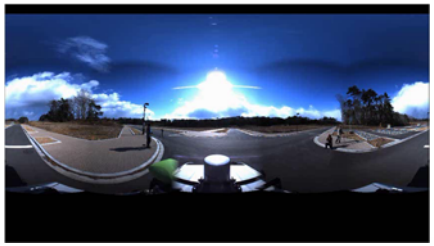
Automated Driving Technologies in Tohoku University



- **Automated Driving Car by conversion of Micro EV (for region)**
- SLAM (Simultaneous Localization and Mapping) technology
  - LIDAR, Camera, RTK-GPS, Odometry



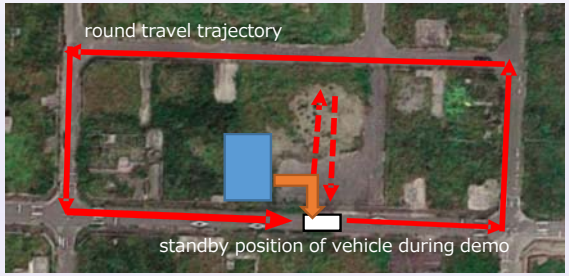
LIDAR



360 degree camera

Automated Driving on public road

- Sensing technology in hard condition (Fire, Fog, Rain, Snow, etc.)
- Practice Field in Special Ward
  - **including public road**
- **Social implementation of automated driving with local needs**
  - **Hard weather condition**
  - **Unmanned vehicle for carrying**
  - **Safety car for aged or diseased person**



Demo Course in Arahama on Mar. 27
(10-15km/h on 350m course)

Driving Simulator（DS）

Virtual Traffic Experiment Environment for Demo, Evaluation & Verification

Evacuation of automobiles from tsunami: Proposal of one-way traffic and change of central lane during disaster and proposal of evacuation training

Prevention of Reverse Run* (Kahoku Interchange)

Before (2015)

After (2016.12)

DS Exp. (2016.1)

Implementation

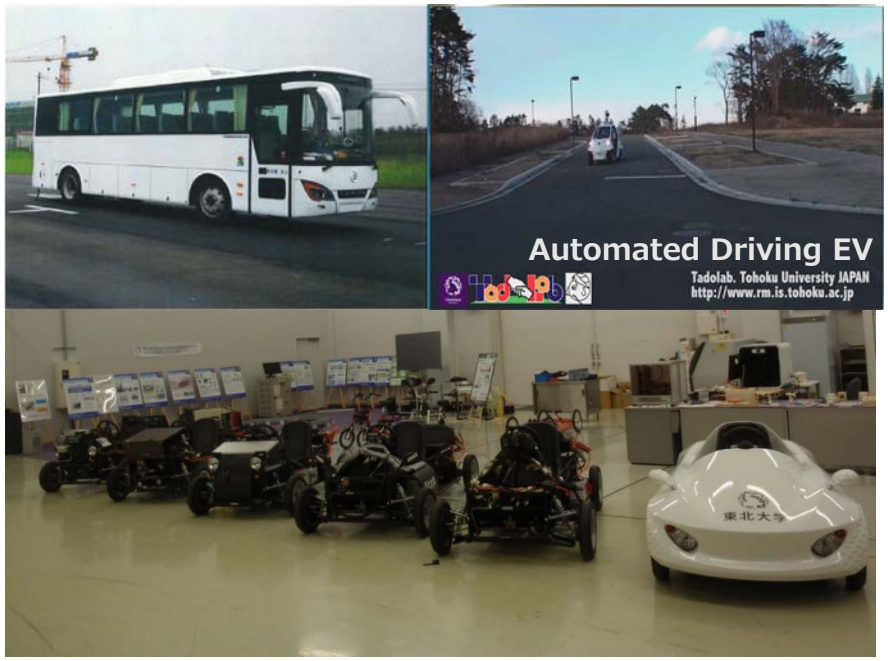
Driving Simulator

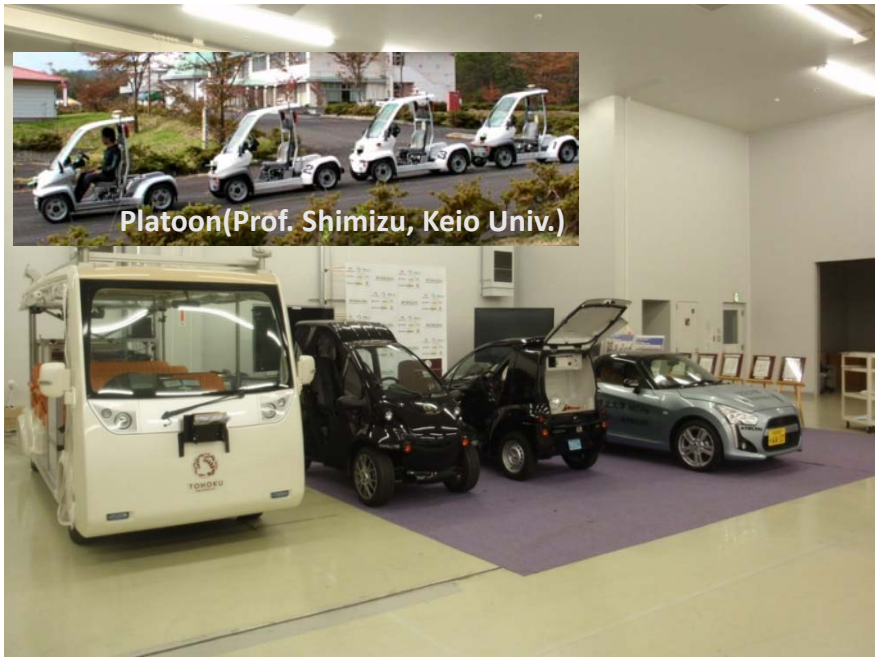
Press Release

The press release itself is a part of reverse run-prevention by making the impression of the countermeasures to many people

*Number of reverse run found **259** in 2016

EV cars converted by Tohoku University

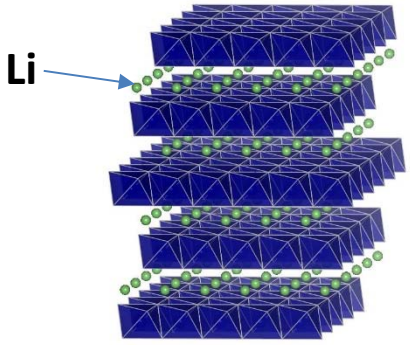
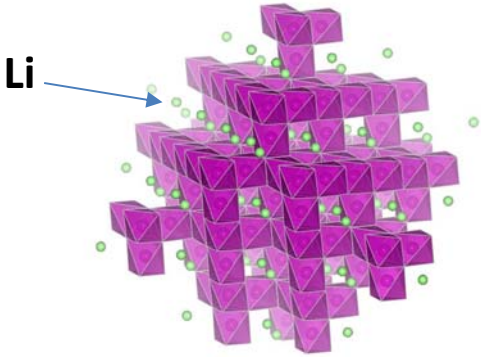




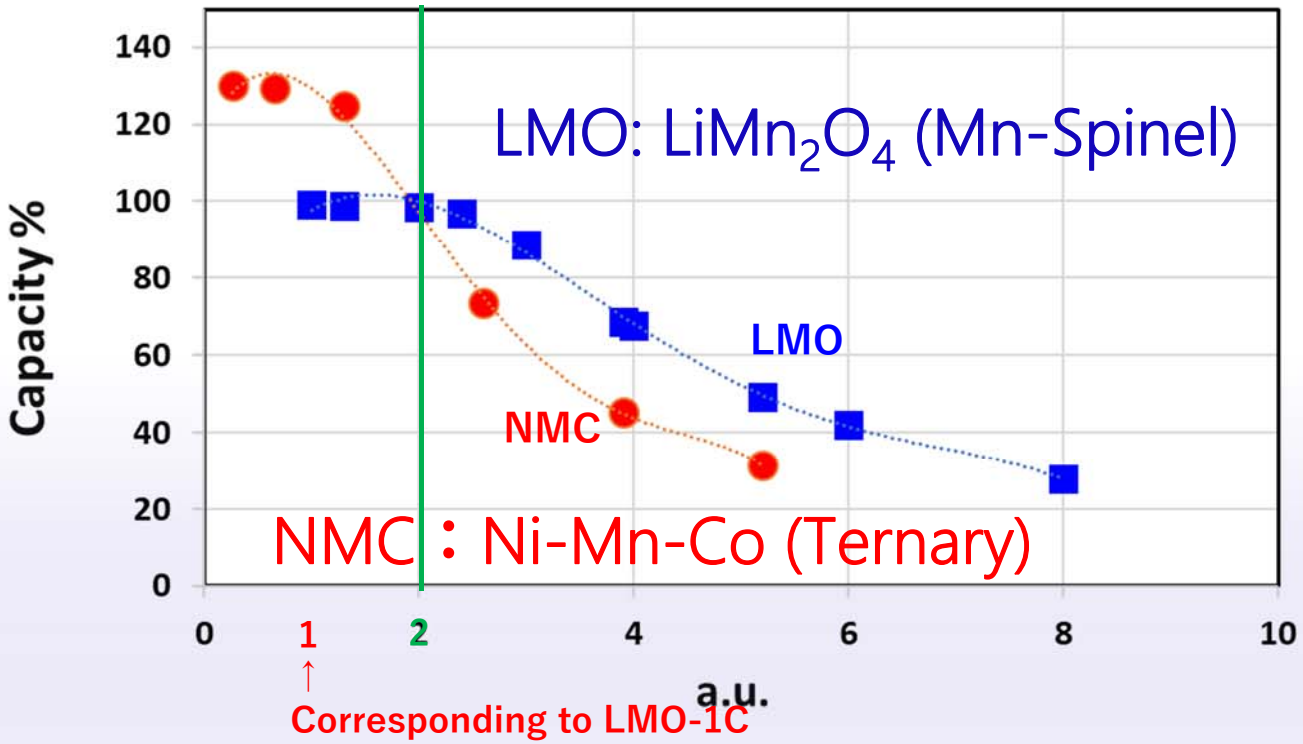
Automated Motion Control | **Wireless Charge For Two People** | **Li-ion Battery Public Road** | **EV Bus (MODI)** | **COMS for two (Toyota Auto Body)** | **COMS for supply (Toyota Auto Body)** | **Copen EV (DAIHATSU)**

PIUS converted cars: MODI(Ichinoseki city) Original

NMC: Ni-Mn-Co(Ternarry) LMO: $LiMn_2O_4$ (Spinel)

	Ternarry NMC Cathode	Mn 系正極
Crystalline Structure	 ・Two-Dimensional Li-Diffusion ・Unstable for Li-ion Over-removal ⇒ Thermorunawy	 ・Three-Dimensional Li-Diffusion ⇒ Advantage for High Power ・Complete Extraction of Li-ion
Cathode-Anode(Carbon) Balance	Li-ion Capacity of Cathode > Li-ion Capacity of Anode ⇒ Cell Management Required	Li-ion Capacity of Cathode = Li-ion Capacity of Anode ⇒ Simplification of Protection Circuit
Reaction with H_2O	○	× ⇒ No Dry Room Required

LMO *vs.* NMC : Output Characteristics



Capacity is larger for the LMO system for high current region (>2C)

Advantage of LiB produced by Tohoku Univ.

⇒ LMO cathode is structural stable and free thermorunaway ➡ Safety

⇒ Dry room free results in facility cost to 1/10 ➡ Production by Local Company

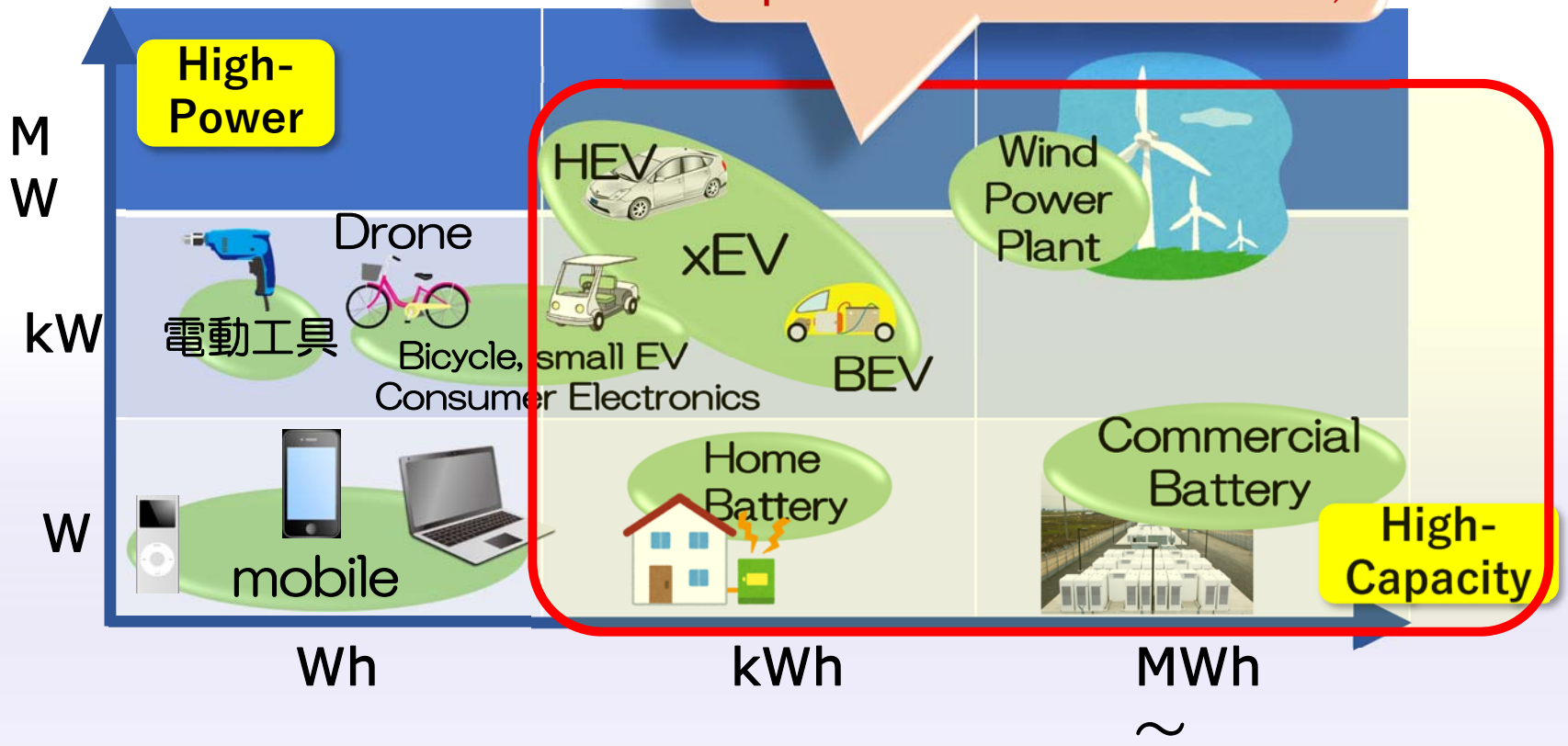
⇒ Provided to regional medical institution ➡ Disaster＋Daily (Secure)

⇒ Status monitoring platform → Network of individual clinics, pharmacies, etc.

Medical＋Energy＋Traffic Total Netwark ⇒ New Lifestyle and Values

Expanding Market

Resilient Society
(A society with high resistance to unpredictable natural disaster etc.)



EV Bus (Powered by Tohoku Univ. LiB) Running around Aobayama New Campus