

Automated Driving Service based at “Michi-no-eki” in Rural Mountainous Areas

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Intelligent Transport Systems

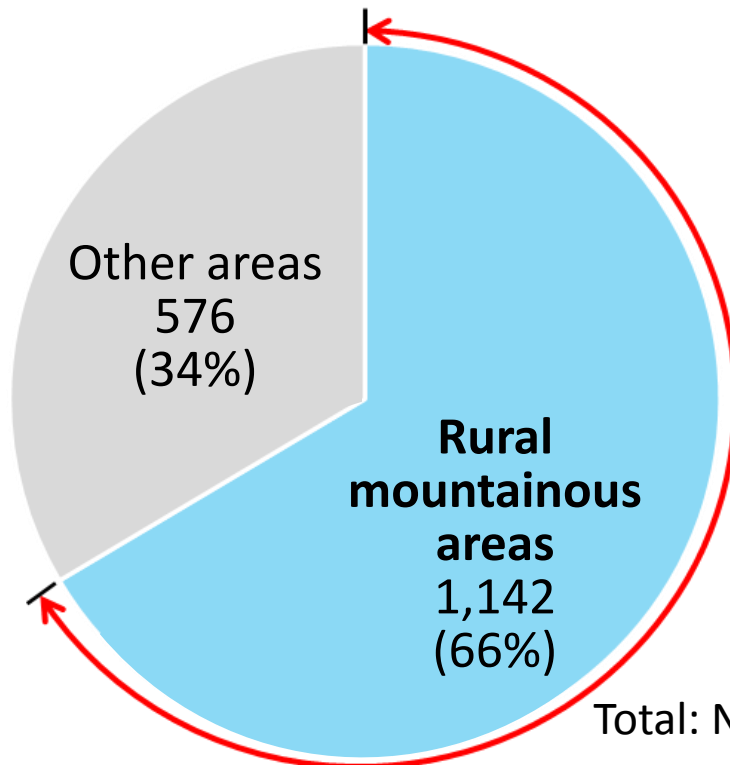
1. Issues in rural mountainous areas in Japan
2. “Michi-no-eki” in Japan
3. Automated driving services based at “Michi-no-Eki” in rural mountainous areas
4. FOT of automated driving service in FY2017

1.1. Rural Mountainous areas in Japan



defined as municipalities

- with large areas of forest (75% or more of total land)
- with farms and rice fields with steep gradient.



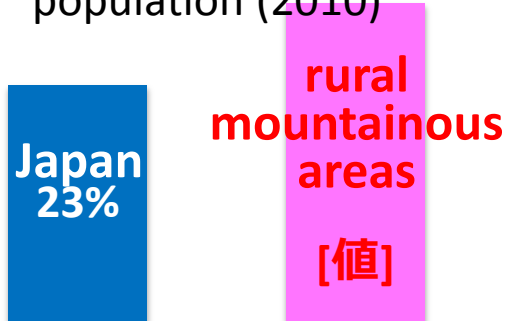
- About 70% of municipalities are located in rural mountainous areas in Japan.

Total: N=1,718 municipalities
(April, 2017)

1.2. Issues in rural mountainous areas

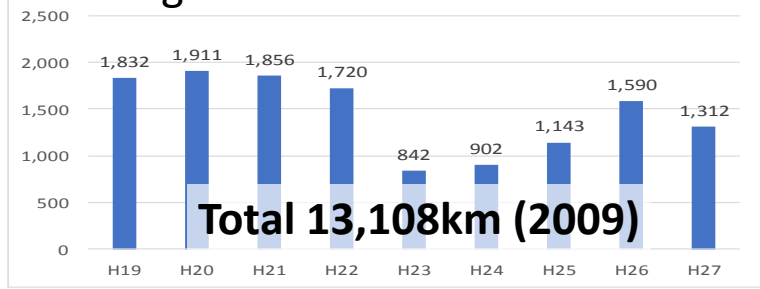
Quickly aging population

Ratio of the population over 65 years old to the total population (2010)



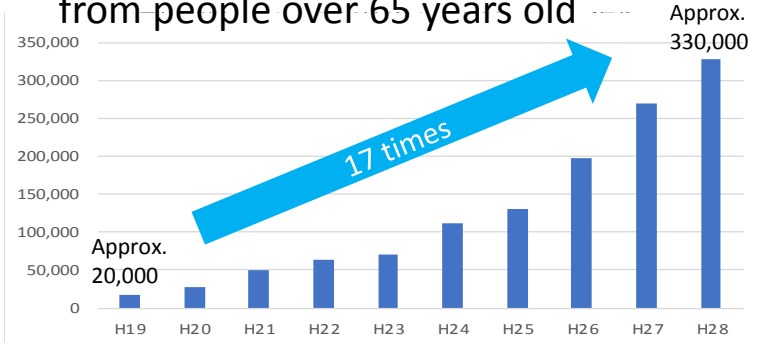
Abolishment of public transport to go shopping and/or to clinics

Length of bus routes abolished



Rapid increase of elderly people who cannot drive

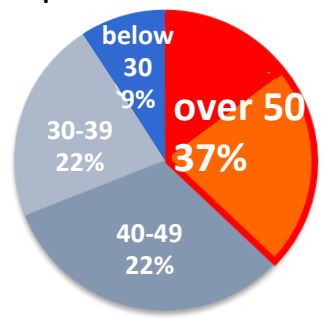
Number of returned driving licenses from people over 65 years old



Shortage of truck drivers who deliver goods

Age group of truck drivers

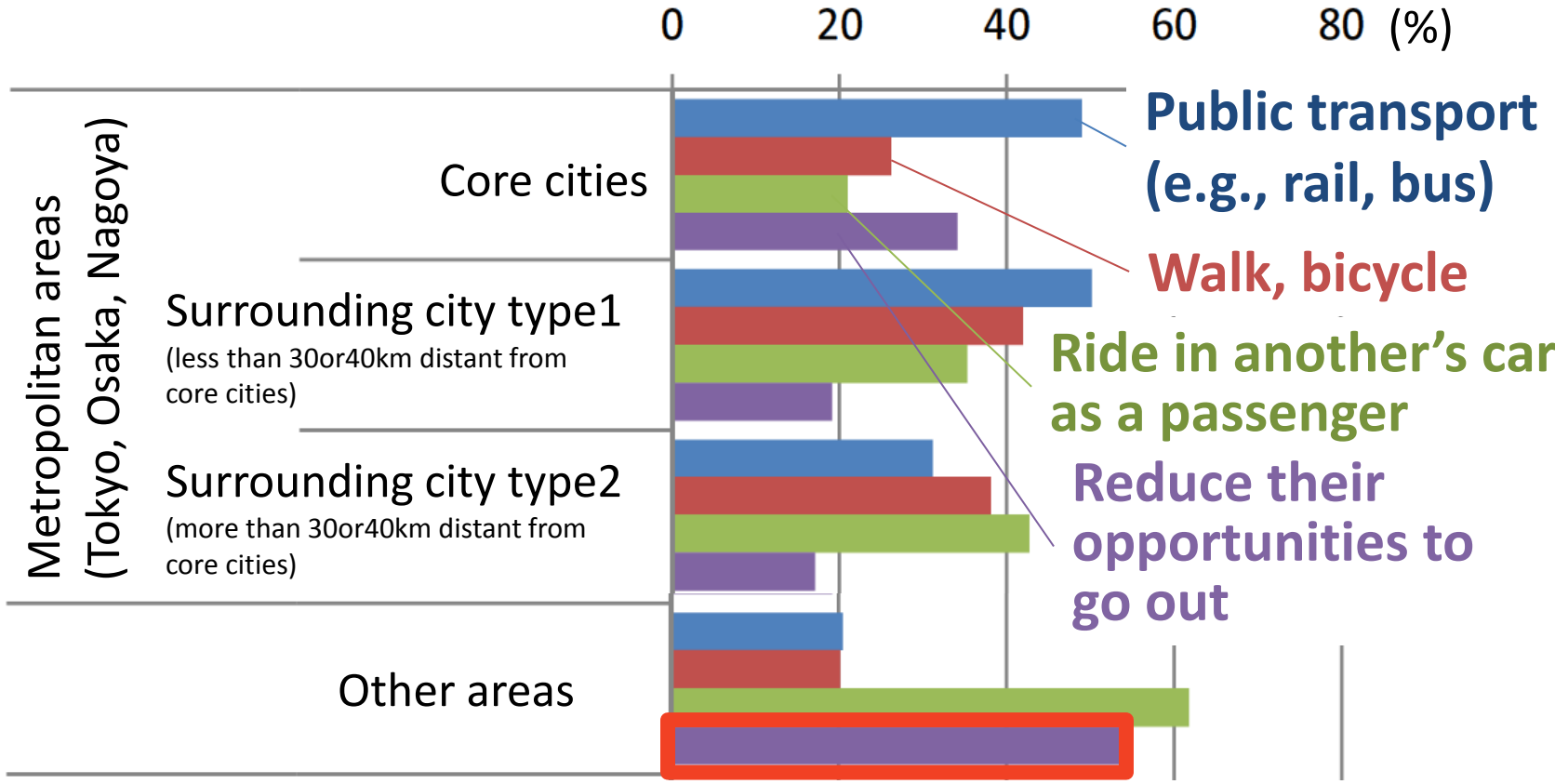
About 40% of truck drivers are over 50 years old.



- It gets difficult to maintain daily-life services in these areas.

1.3.Means of Transport after giving up driving (people over 75 years old)

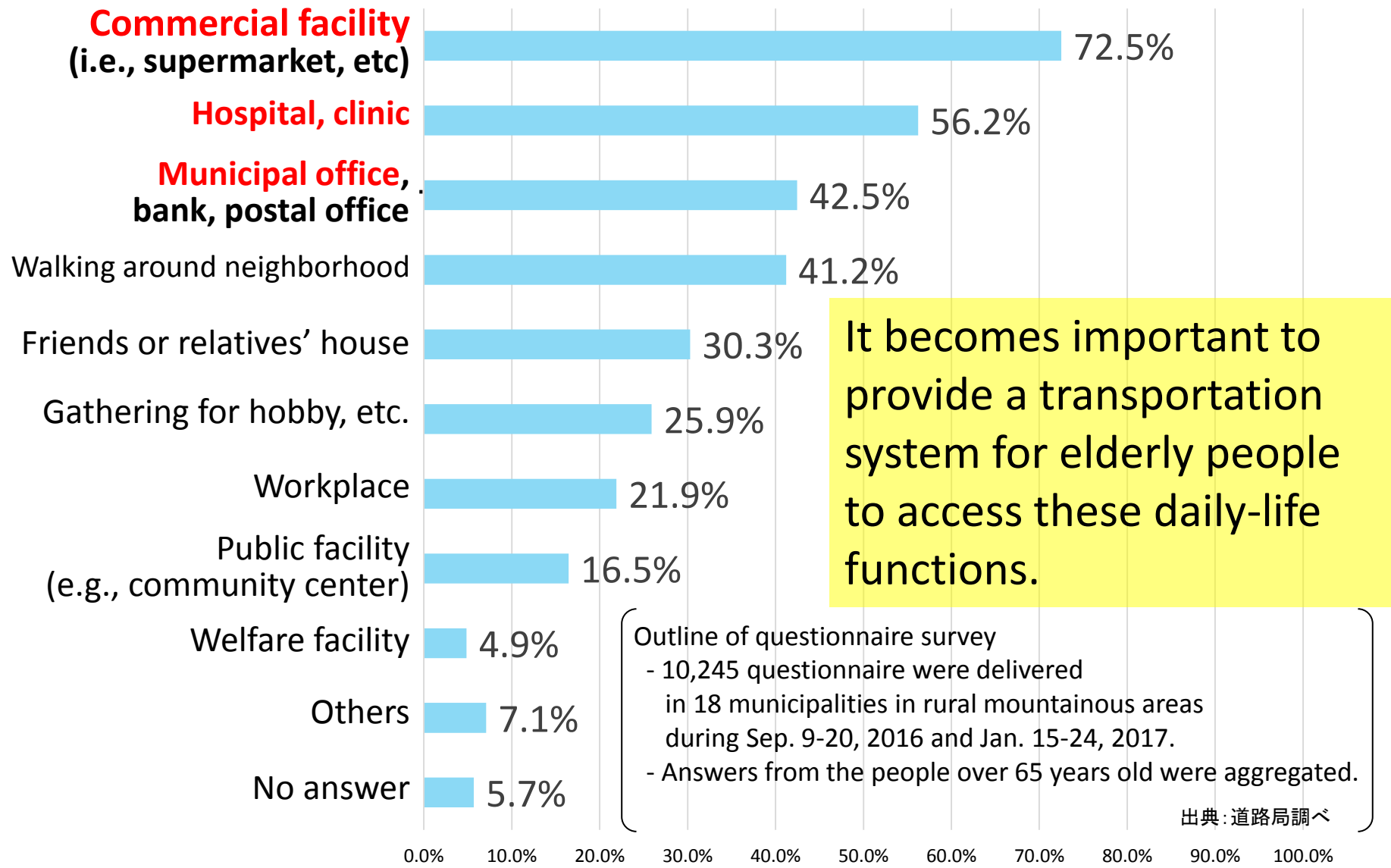
- After giving up driving by themselves, about 50% of the people over 75 years old **reduce their opportunities to go out**.



(2010)

1.4.Places where elderly people go (over 60 years old)

(allow multiple answers) N=2,077



It becomes important to provide a transportation system for elderly people to access these daily-life functions.

Outline of questionnaire survey
 - 10,245 questionnaire were delivered in 18 municipalities in rural mountainous areas during Sep. 9-20, 2016 and Jan. 15-24, 2017.
 - Answers from the people over 65 years old were aggregated.

出典: 道路局調べ

2.1. "Michi-no-eki" (roadside station)

-Rest area along roads

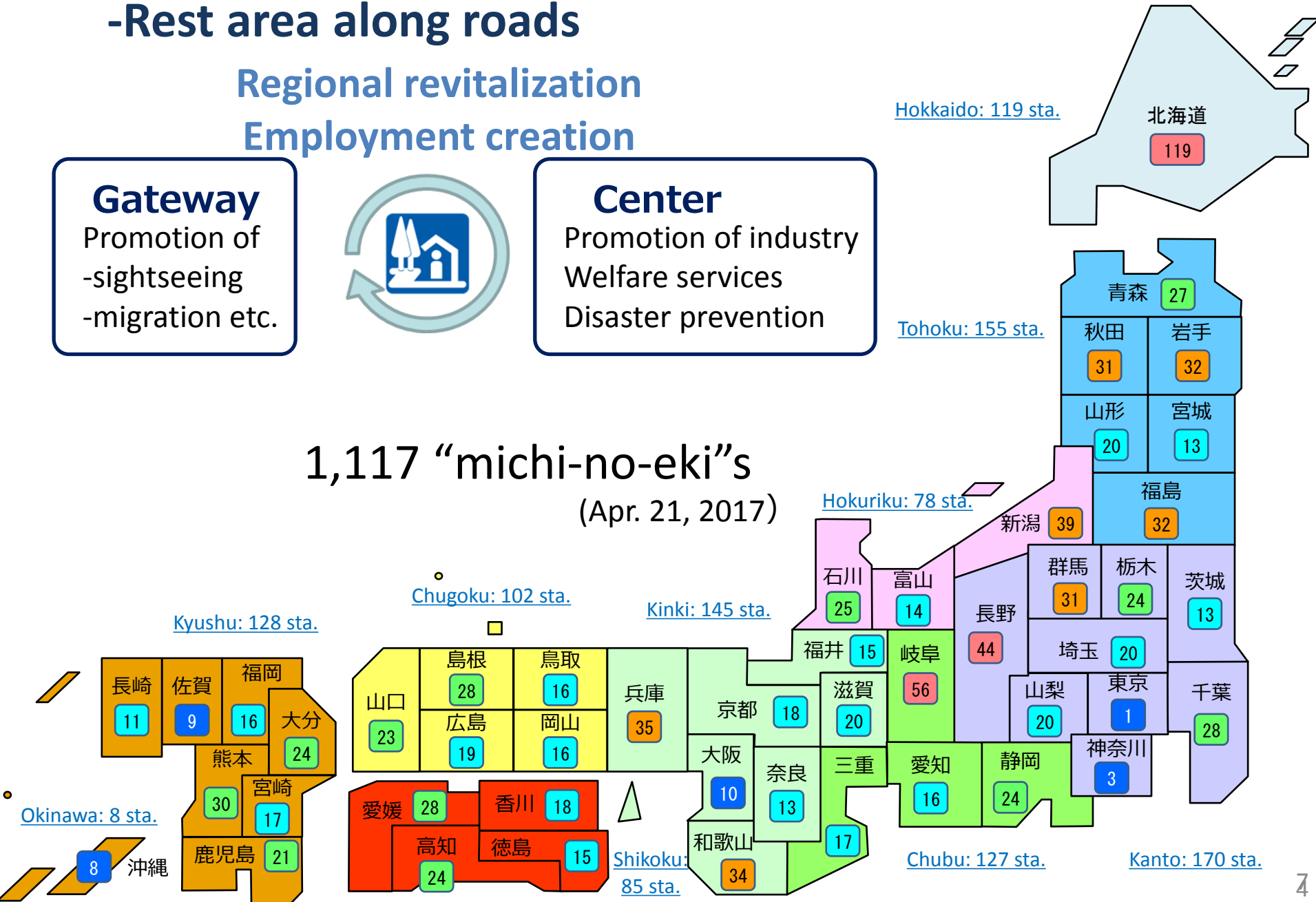
Regional revitalization
Employment creation

Gateway
Promotion of
-sightseeing
-migration etc.



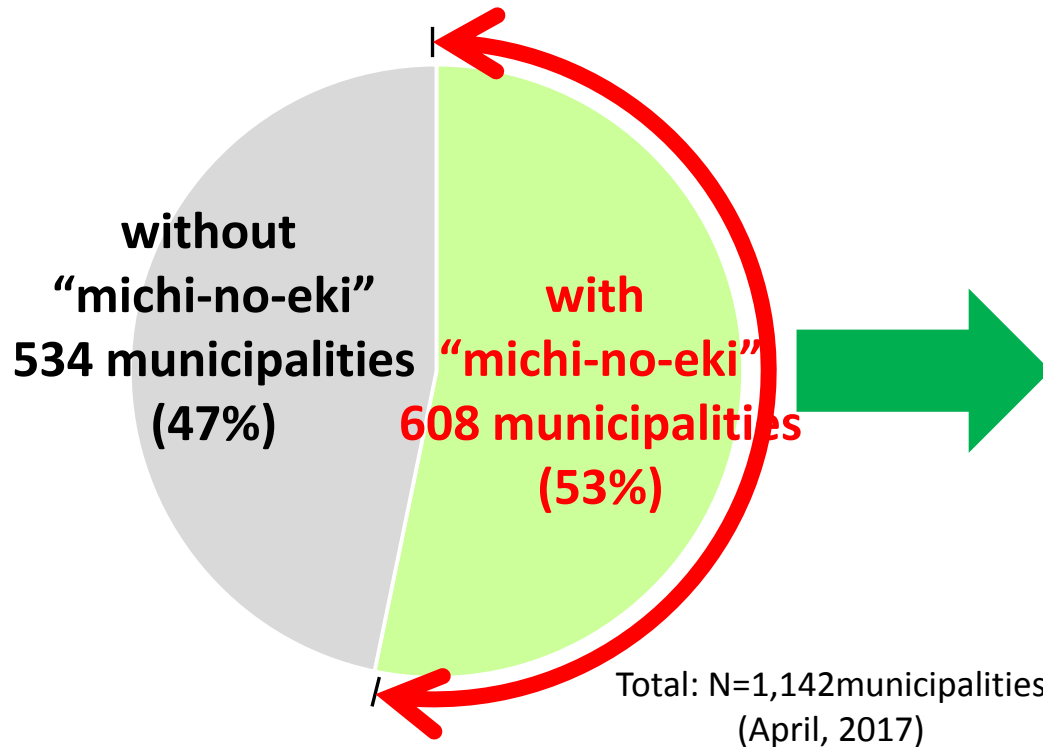
Center
Promotion of industry
Welfare services
Disaster prevention

1,117 "michi-no-eki"s
(Apr. 21, 2017)



2.2. “Michi-no-eki” in rural mountainous areas

- More than half of the municipalities in rural mountainous areas have “Michi-no-eki”s.



- 29 million people (about 23% of total population) live here.
- 876 “michi-no-eki”s (about 80% of total) are located here.

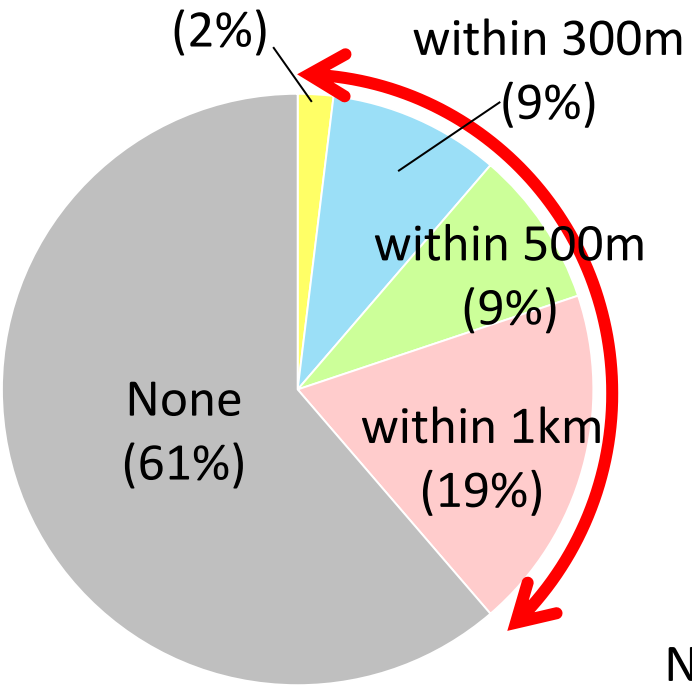
- “Michi-no-eki”s can be utilized for solving the issues in rural mountainous areas.

2.3. Facilities around “michi-no-eki”s in rural mountainous areas (1)

Hospital, clinic

339 michi-no-ekis (about 39% in total) have hospital or clinic within 1km (in Euclid distance).

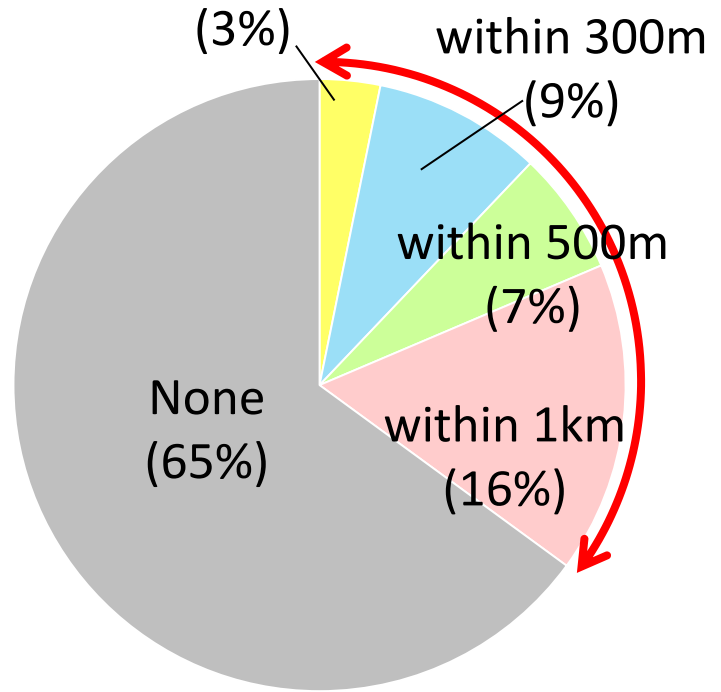
inside michi-no-eki



Municipal office

307 michi-no-ekis (about 35% in total) have municipal office within 1km (in Euclid distance).

inside michi-no-eki

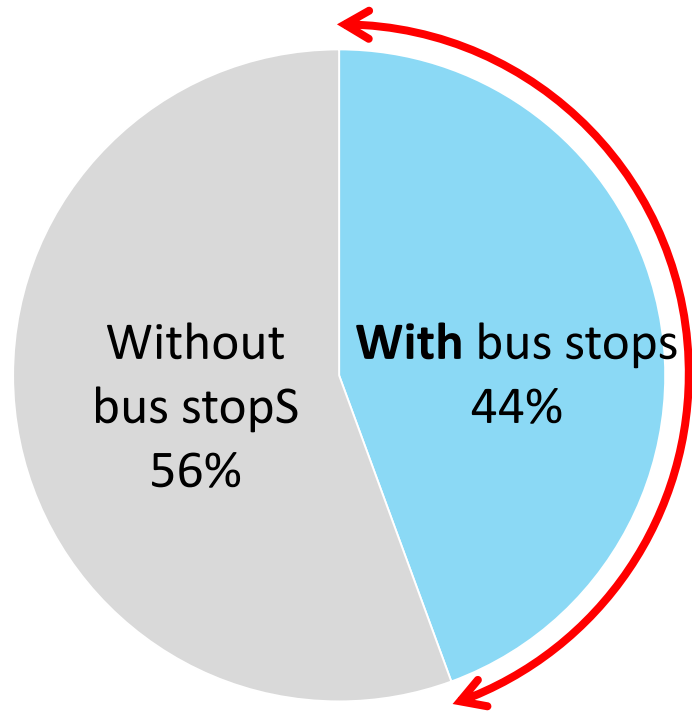


N=876 stations
(April, 2017)

2.3. Facilities around “michi-no-eki”s in rural mountainous areas (2)

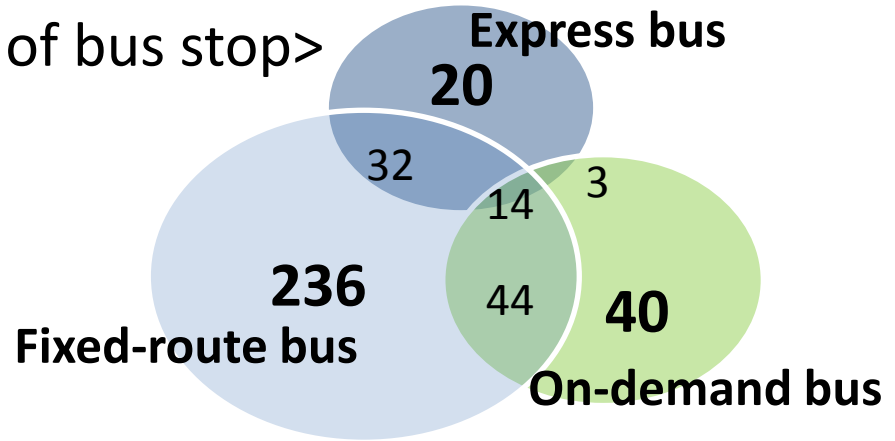
Bus stop

389 michi-no-ekis (about 44% in total) have bus stops.



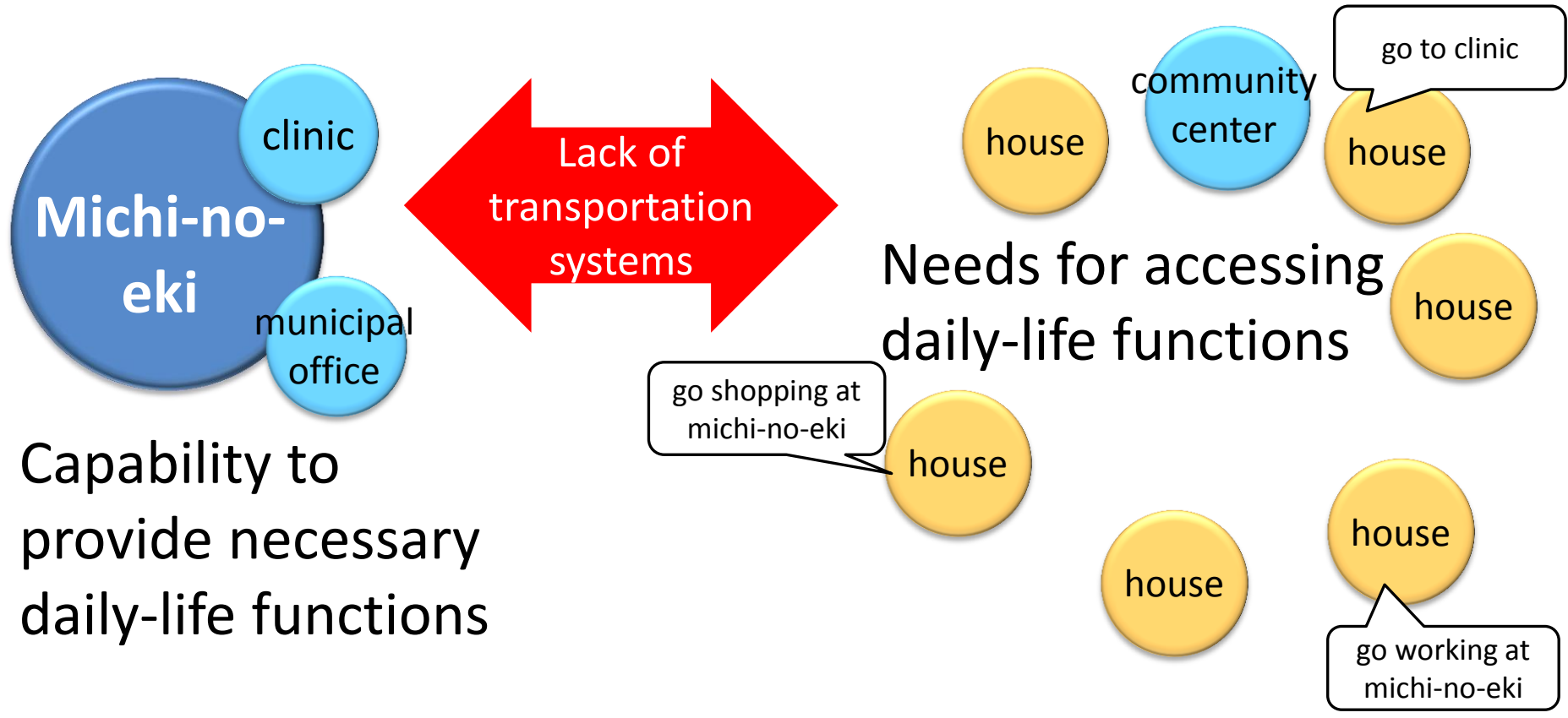
N=876 stations (April, 2017)

<Type of bus stop>



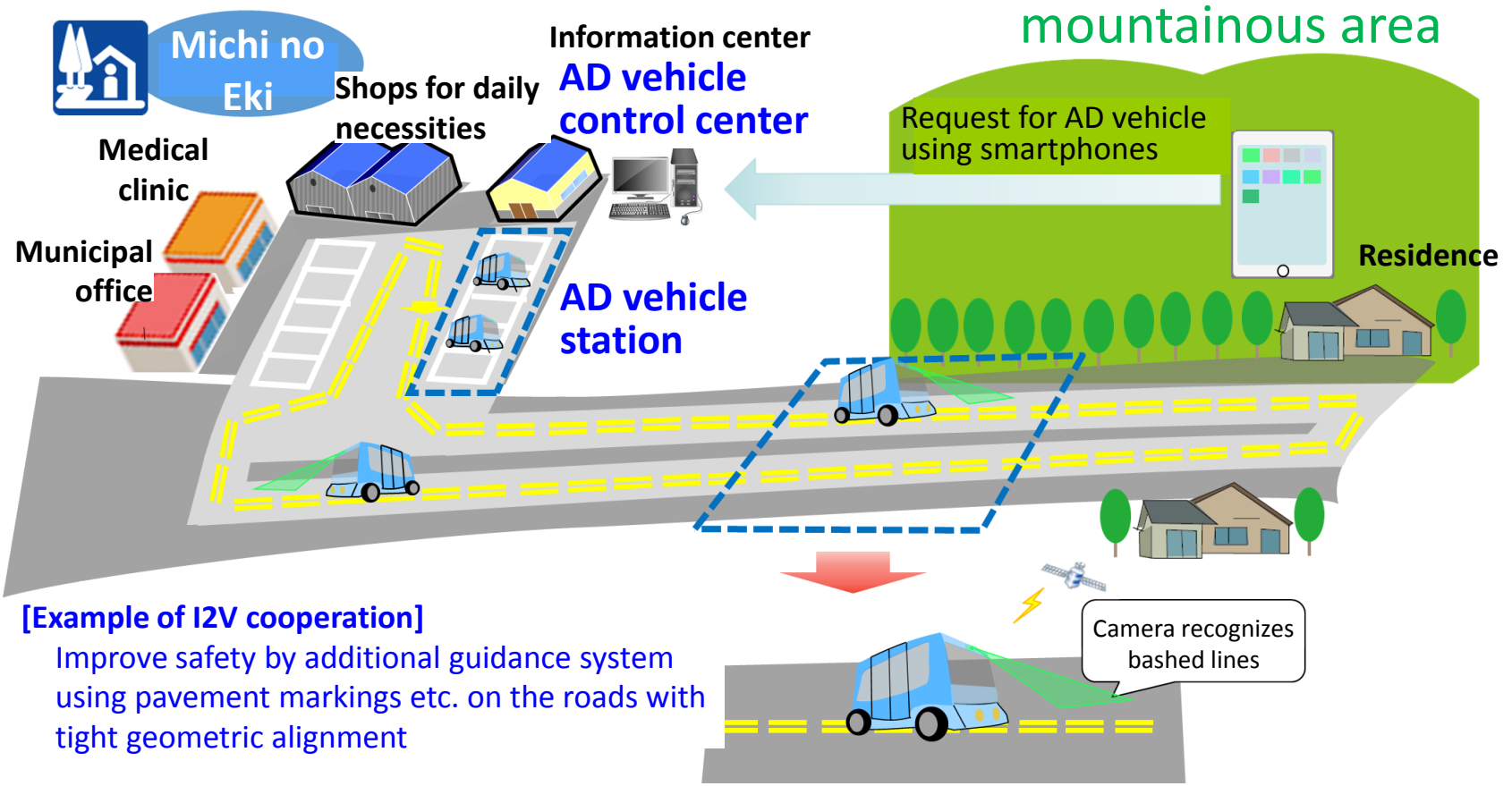
Many “michi-no-eki”s can provide necessary functions for elderly people.

3.1. Automated driving service based at “Michi-no-Eki” in rural mountainous areas



A mobility service using automated driving technology is expected to solve the issue.

3.2. Automated driving service based at “Michi-no-Eki” in rural mountainous areas



[Example of I2V cooperation]
 Improve safety by additional guidance system using pavement markings etc. on the roads with tight geometric alignment

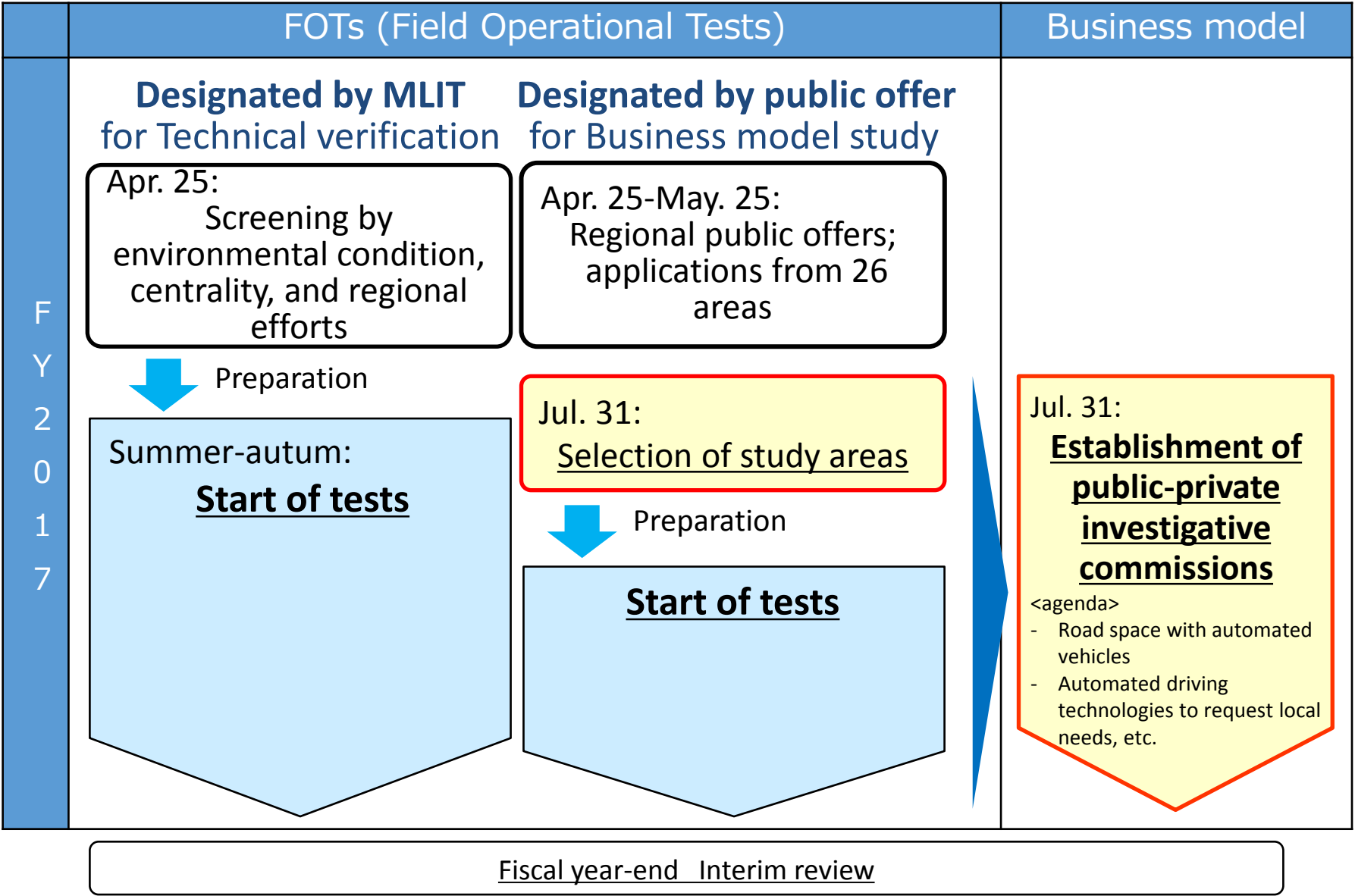
Combined transport of cargo and passengers

Ensuring people’s daily transport needs
 (shopping, medical care, public services, etc.)

Ensuring the flow of goods
 (collection and shipment)

Regional vitalization
 (tourism, workplaces etc.)

4.1. Schedule in FY2017



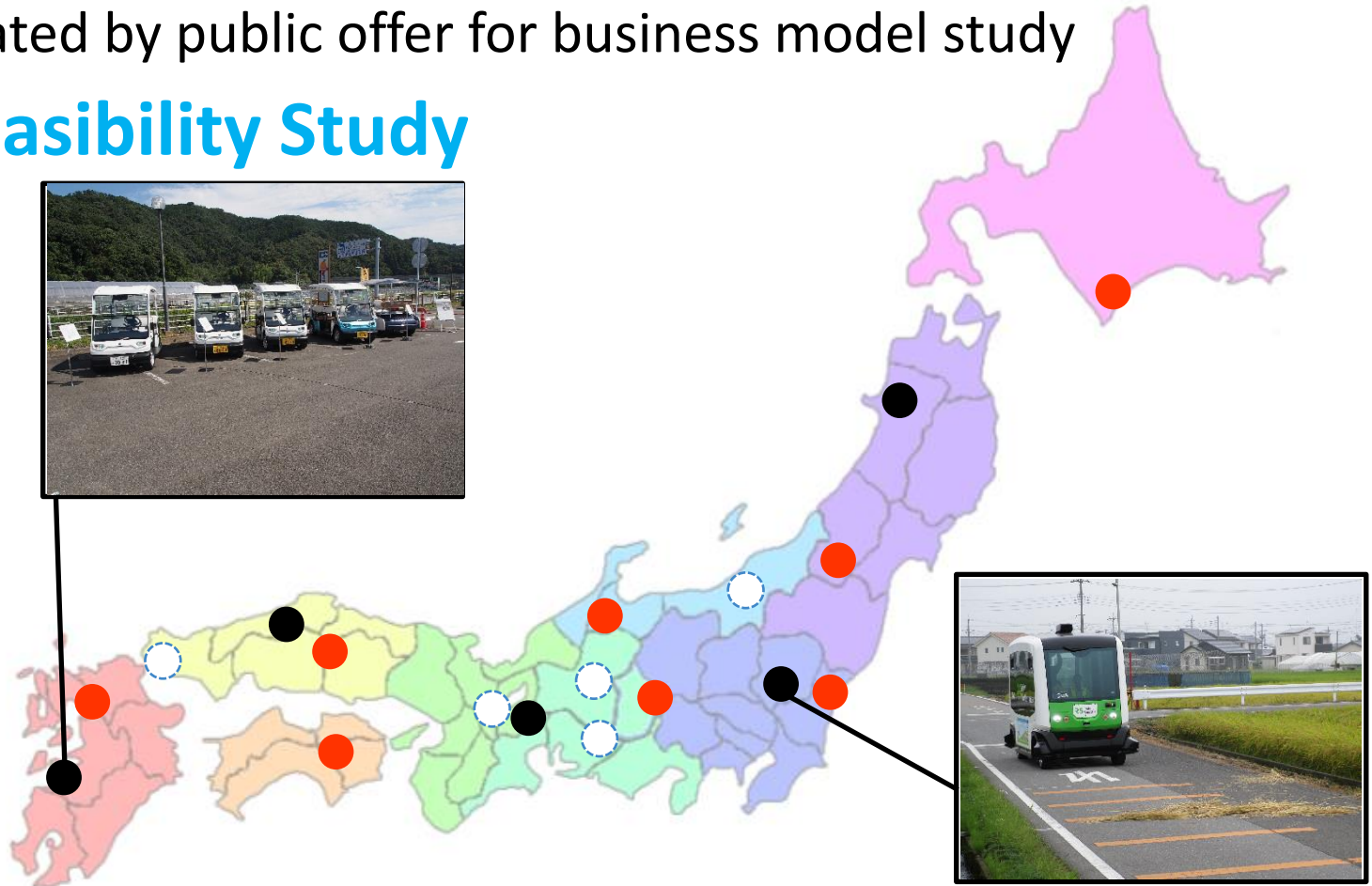
4.2. Test sites

“Michi-no-eki”s





- designated by MLIT for technical verification
- designated by public offer for business model study
- designated by public offer for business model study

➔ FOTs

➔ Feasibility Study



4.3. Test-vehicles

Bus type	Passenger-car type
<p>1) DeNA Co., Ltd.</p>  <p>Autonomous technology</p> <ul style="list-style-type: none"> Identify own position by GPS and IMU. Drive according to a predetermined route. Acquire point-group data. <p>Capacity: 6 people (seated) (Total 10 people seated and standing)</p> <p>Speed: Approx. 10km/h (Max: 40km/h)</p>	<p>3) Yamaha Motor Co., Ltd.</p>  <p>V2I technology</p> <ul style="list-style-type: none"> Drive a predetermined route by following embedded magnetic-induction lines. <p>Capacity: Approx. 4-6 people</p> <p>Speed: Automated: Approx. 12km/h Manual: <20km/h</p>
<p>2) Advanced Smart Mobility Co., Ltd.</p>  <p>V2I technology</p> <ul style="list-style-type: none"> Identify own position and drive a predetermined route using GPS, magnetic markers and gyro sensors. <p>Capacity: 20 people</p> <p>Speed: Approx. 35km/h Max. 40km/h</p>	<p>4) Aisan Technology Co., Ltd.</p>  <p>Autonomous technology</p> <ul style="list-style-type: none"> Drive a predetermined route using a high-precision 3D map. Detect surrounding conditions by LIDAR. <p>Capacity: 4 people</p> <p>Speed: Approx. 40km/h Max. 50km/h</p>

GPS: Global Positioning System
 IMU: Inertial Measurement Unit
 LIDAR: Light/Laser Imaging Detection and Ranging

Note: Vehicle speed responds to the posted speed limit of each road.



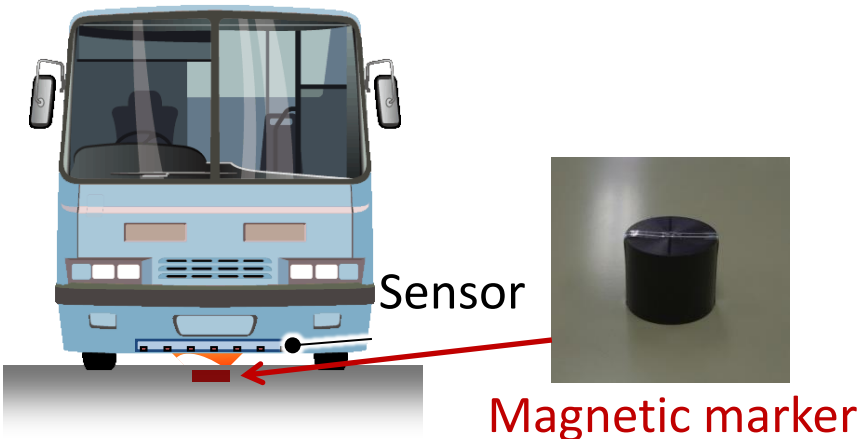
4.4. V2I cooperation technologies for rural areas

- Severe environmental condition in rural area.
 - AD vehicle cannot catch GPS signal due to forest.
 - Performance of Lidar sensors decrease in snowy condition.

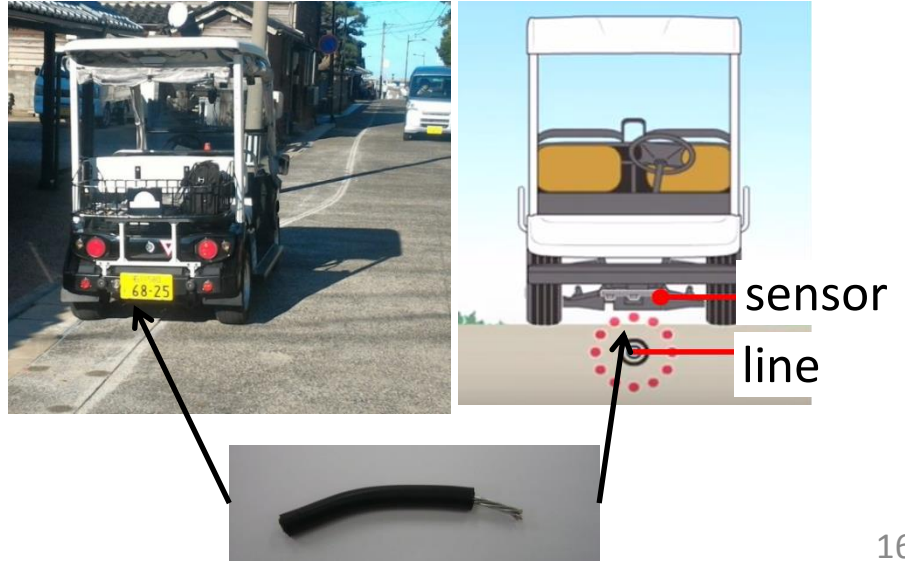


- Use of low-tech but robust technology against severe weather in order for vehicles to **identify their own location accurately**

Magnetic markers (Advanced Smart Mobility Co., Ltd)

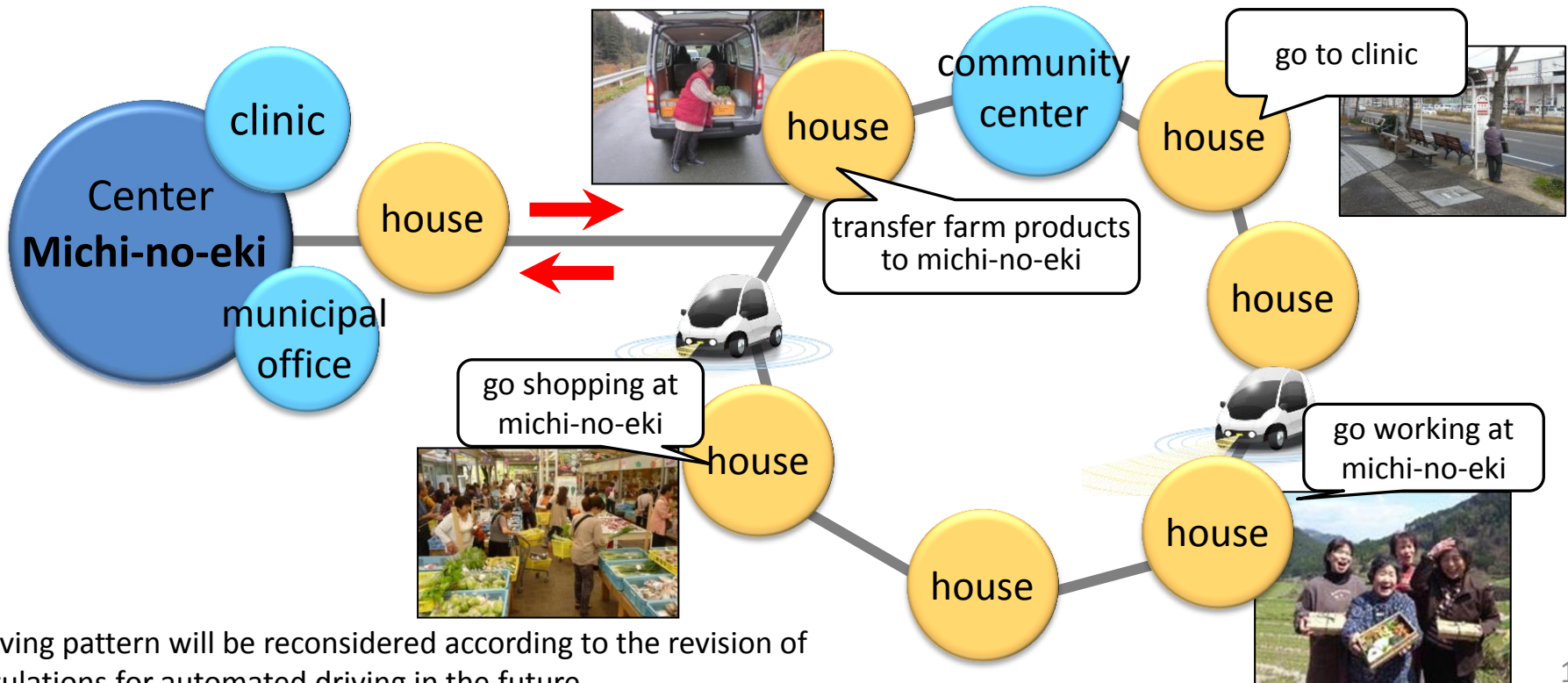


Magnetic-induction lines (Yamaha Motor Co., Ltd.)



4.5. Driving route

Route	“Michi-no-eki” as a center ~ private houses ~ clinic, municipal office, etc.
Total length	Approximately 4~5 km
Driving pattern*	(1) driving on designated roads for automated vehicles by traffic regulation with staff in case of emergency (level 4) (2) driving on designated roads as well as on public roads (in mixed traffic) with a driver (level 4 + level 2)
Operation	(a) Fixed time table (2) On-demand operation by smartphones



*Driving pattern will be reconsidered according to the revision of regulations for automated driving in the future.

4.6. Evaluation viewpoint

1) Roads and traffic



e.g., Typical road in rural area

- 1) Road structure (Straightness, grade, width, etc.)
- 2) Road management (demarcation lines, planted trees, etc.)
- 3) Support for mixed traffic
- 4) Space required in bases

2) Environments



e.g., Snowy roads

- 1) Weather conditions (Rain, snow, etc.)
- 2) Communication conditions (GPS reception)

3) Costs



e.g., Installation magnetic induction lines

- 1) Cost of introduction and maintenance of vehicles
- 2) Costs other than related to vehicles

4) Public acceptance



e.g., Vehicle in use

- 1) Comfort (speed, psychological impact, etc.)
- 2) Convenience (routes, frequency of service, etc.)

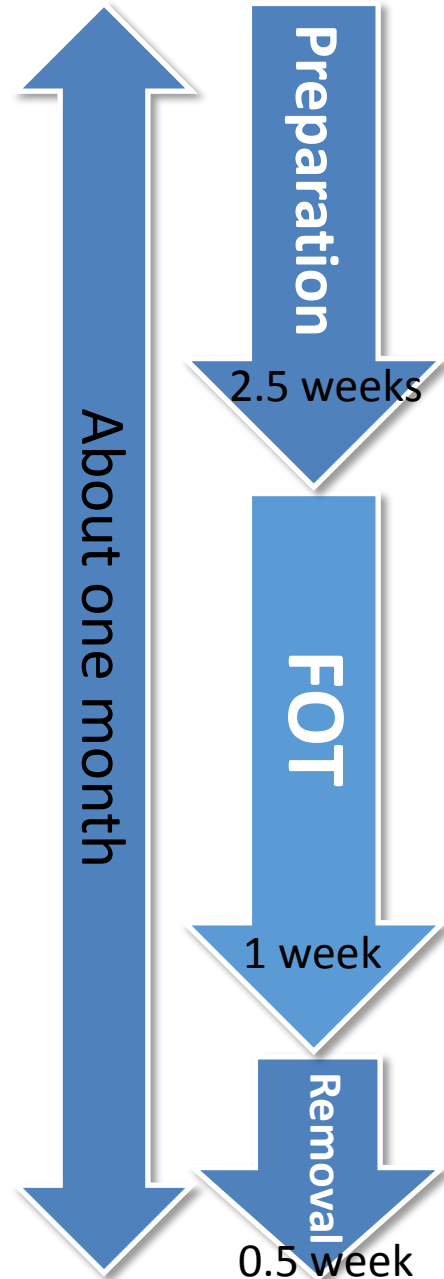
5) Beneficial effects on regions



e.g., Passengers and freight are transported together.

- 1) Opportunity for elderly to go out
- 2) Collection and shipping of agricultural produce, etc.

4.7.FOT schedule



□ Arrangement with related organization and people

- Agreement with local police, residents, etc.
- Public relations with road users, etc.

□ Creation of the test field

- Barriers for designated area, magnetic markers for V2I, etc.
- Point group data needed for autonomous driving, etc.

□ Without passengers

- Ability on narrow and/or steep road
- Ability on snowy roads, etc.



□ With passengers

- Psychological influence
- Combined transport of cargo and passengers
- Convenience of on-demand operation by smartphone, etc.



□ Reinstatement of the test field

- Removal of barriers, magnetic markers, etc.

Snapshot in a FOT in Ashikita

(Kumamoto-pref)

Roads and traffic



Beneficial effects on regions



Public acceptance



Thank you for your kind attention!

