Demonstration Project for Fuel Cell Bus

National Traffic Safety and Environment Laboratory
Kazuyuki Narusawa

Background

- **Public road tests**

  - Public road tests have begun since September 2002 by auto-manufacturers.

  - Taking quantitative measurement data of FCV performance.

- **Fuel Cell Bus Service**

  - Fuel cell buses have received a government permission for trial operation January 2002.

  - The Fuel cell bus on road service has started August 28th 2003 in Tokyo.

  - The first Fuel cell bus to enter into service in Japan.

The Fuel Cell Bus Demonstration Project in Japan

(2003-2004)

Project to Promote Development of Next-Generation Low Emission Vehicles
Ministry of Land, Infrastructure and Transport
National Traffic Safety and Environment　Laboratory

JHFC Project
Ministry of Economy, Trade and Industry,
Japan Automobile Research Institute,　Engineering Advancement Association

FC Bus Pilot Project in Tokyo
Tokyo Metropolitan Government, Toyota Motor Corp., Hino Motors

東京都

FC Bus Refueling Station Pilot Project in Tokyo
Tokyo Metropolitan Government, Shell/Iwatani

Objectives

Trial Operation for Fuel Cell Bus

Project to Promote Development of Next-Generation Low Emission Vehicles
Ministry of Land, Infrastructure and Transport
National Traffic Safety and Environment Laboratory (NTSEL)

- As a part of the Project to Promote Development of Next-Generation Low Emission Vehicles, the Working Group for the fuel cell bus trial operation was organized.

<Objectives>

- Collect data relating to safety and environmental issues for establishing safety standards for FC bus .
- To raise public awareness regarding FC bus.
- sending messages to promote FC buses

Fuel Cell Bus

Specifications

Vehicle	Base Platform	Hino-Blueribbon Ci t y
	Dimensions L x W x H	10,515 x 2,490 x 3,360 m/m
	Max. Speed	80 km/h
	Occupant Capacity	61 persons
FC Stack	Type	PEFC (in-house)
	Output Power	90 kW x 2
Motor	Type	AC Synchronous (in-house)
	Max. Power	80 kW x 2
	Max. Torque	260 N.m x 2
Fuel	Type	Compressed Hydrogen
	Storage	High Pressure Hydrogen Tank
	Max. Pressure	35 MPa
Battery	Type	Ni-MH Battery

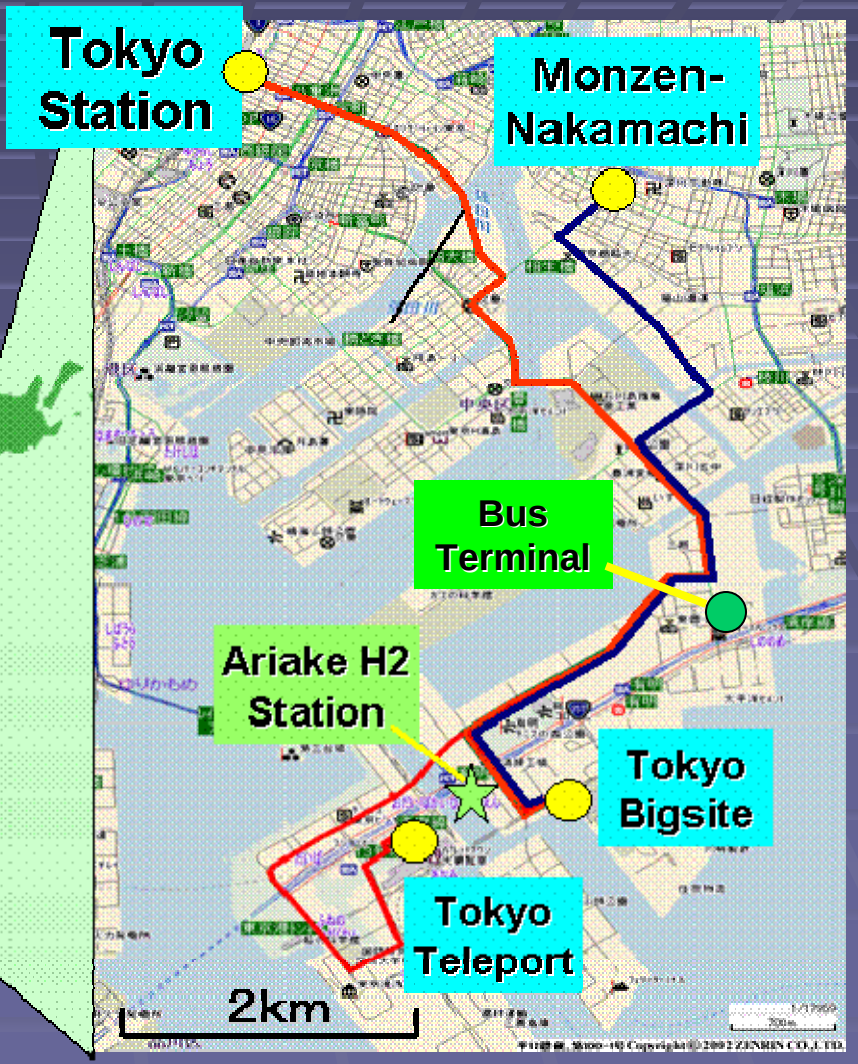
Exterior of the Fuel Cell Bus

http://www2.kankyo.metro.tokyo.jp/sgw/renewable/bus/sikiten-030827/toujitu-report.htm

Interior

Fuel Cell Bus Service in Tokyo

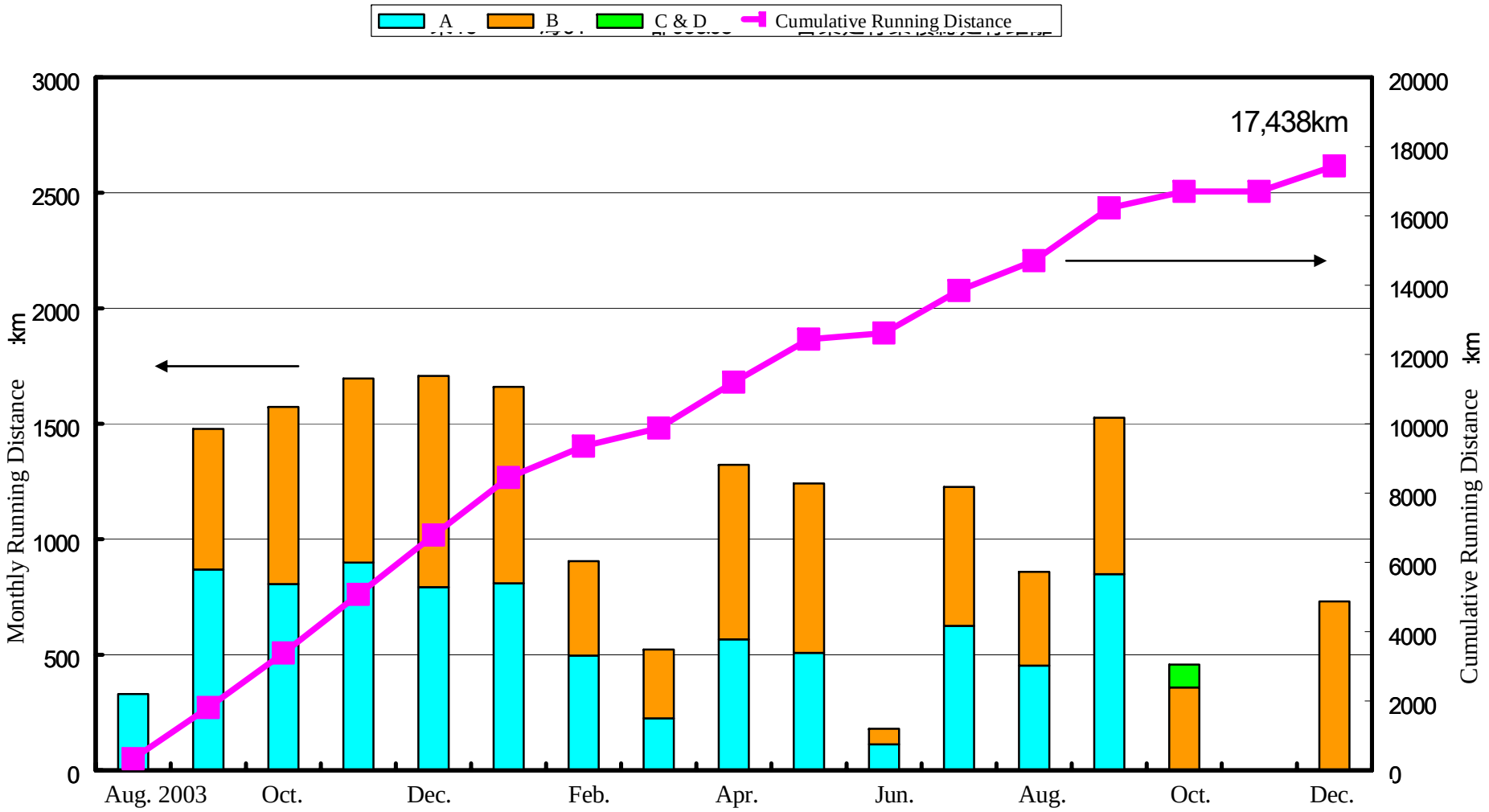
Term	Aug. 2003 - Dec.2004
Vehicle	FCHV-BUS2 (1 unit)
Route	2 routes of 20 to 40 km
	3 to 4 round-trips per day



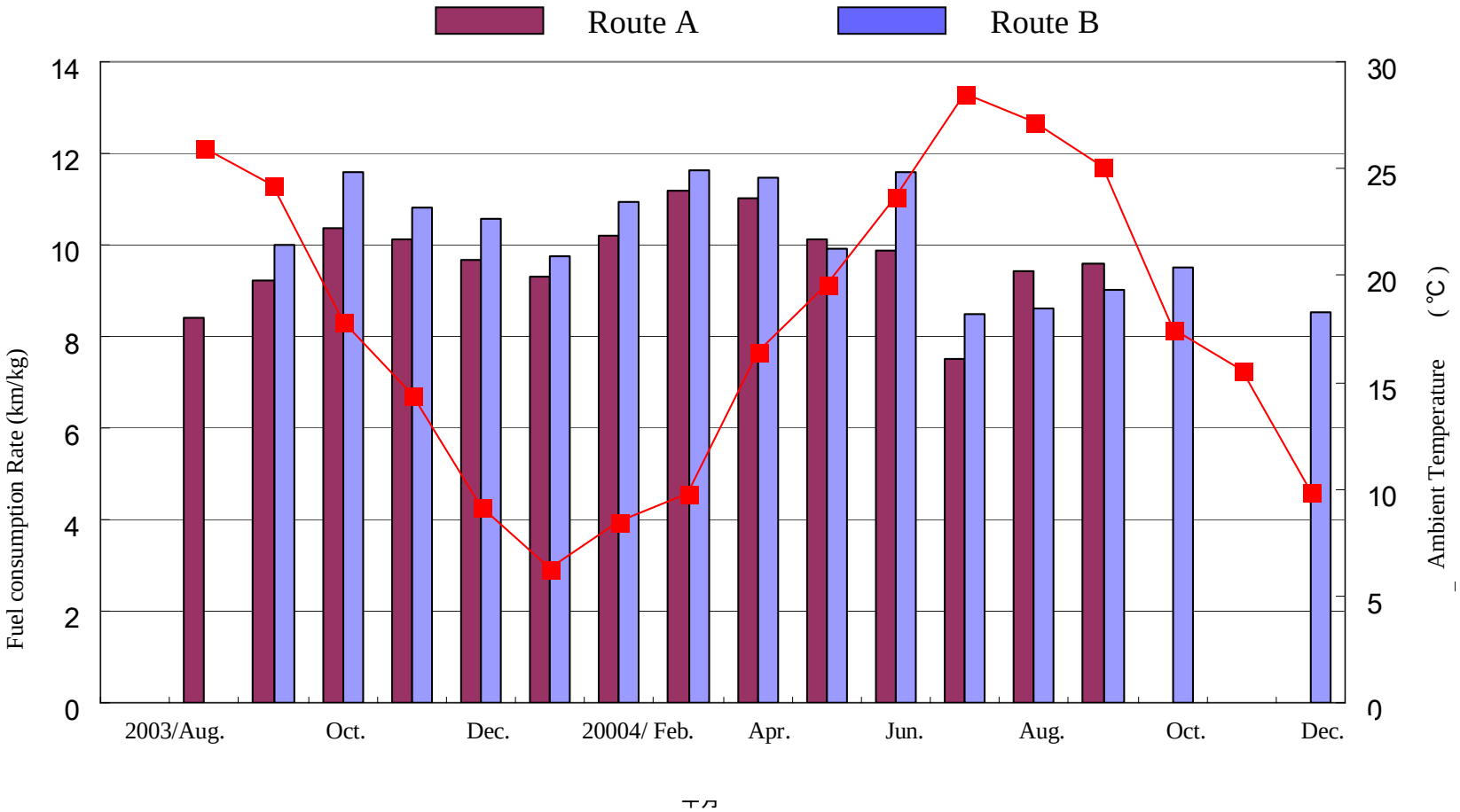
Fuel Cell Bus Service Summary

A: East 16 : Tokyo Station Yaesu Exit – Tokyo Big Sight / Tokyo Teleport Station

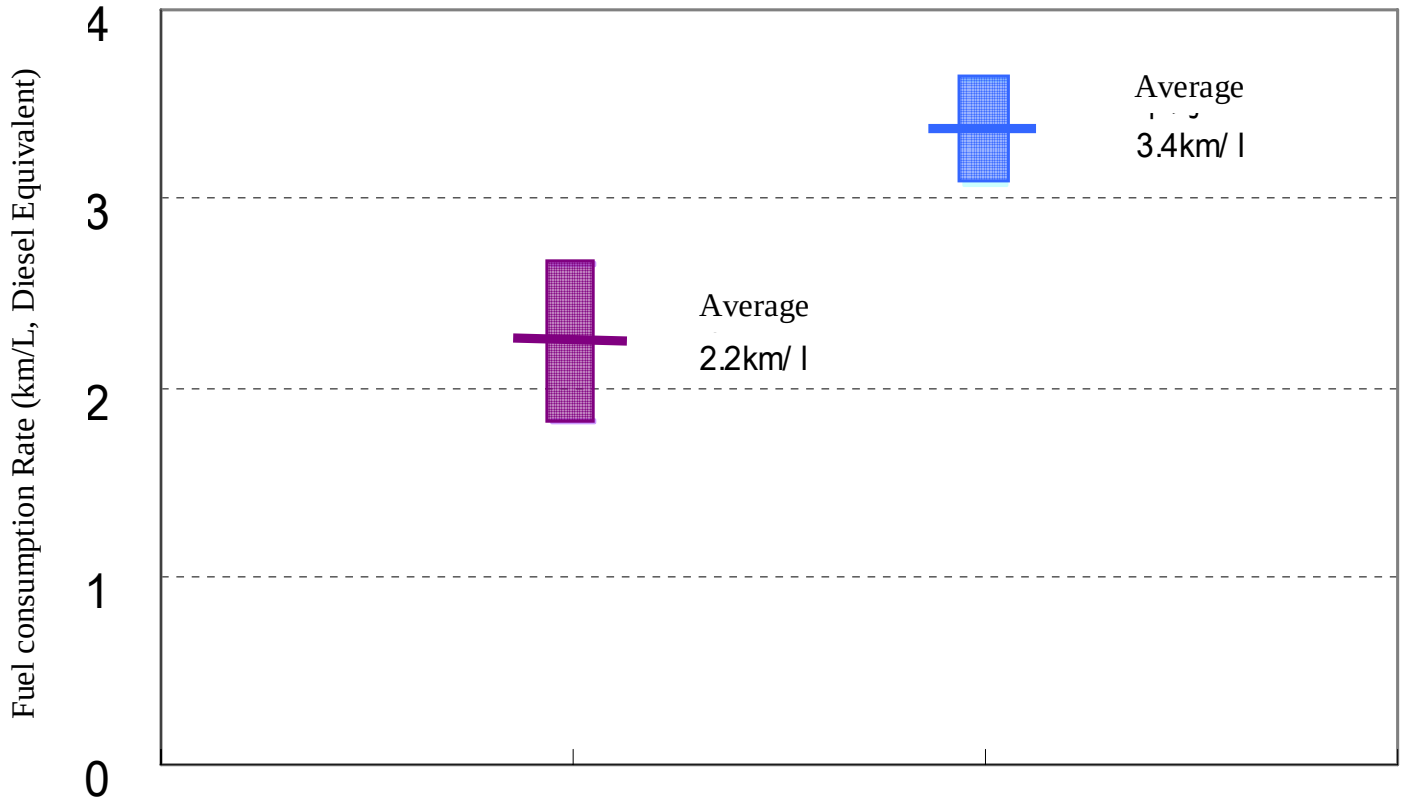
B: Seaside 01 : Monzennakacho – Tokyo Big Sight / Tokyo Teleport Station



Monthly Fuel Consumption



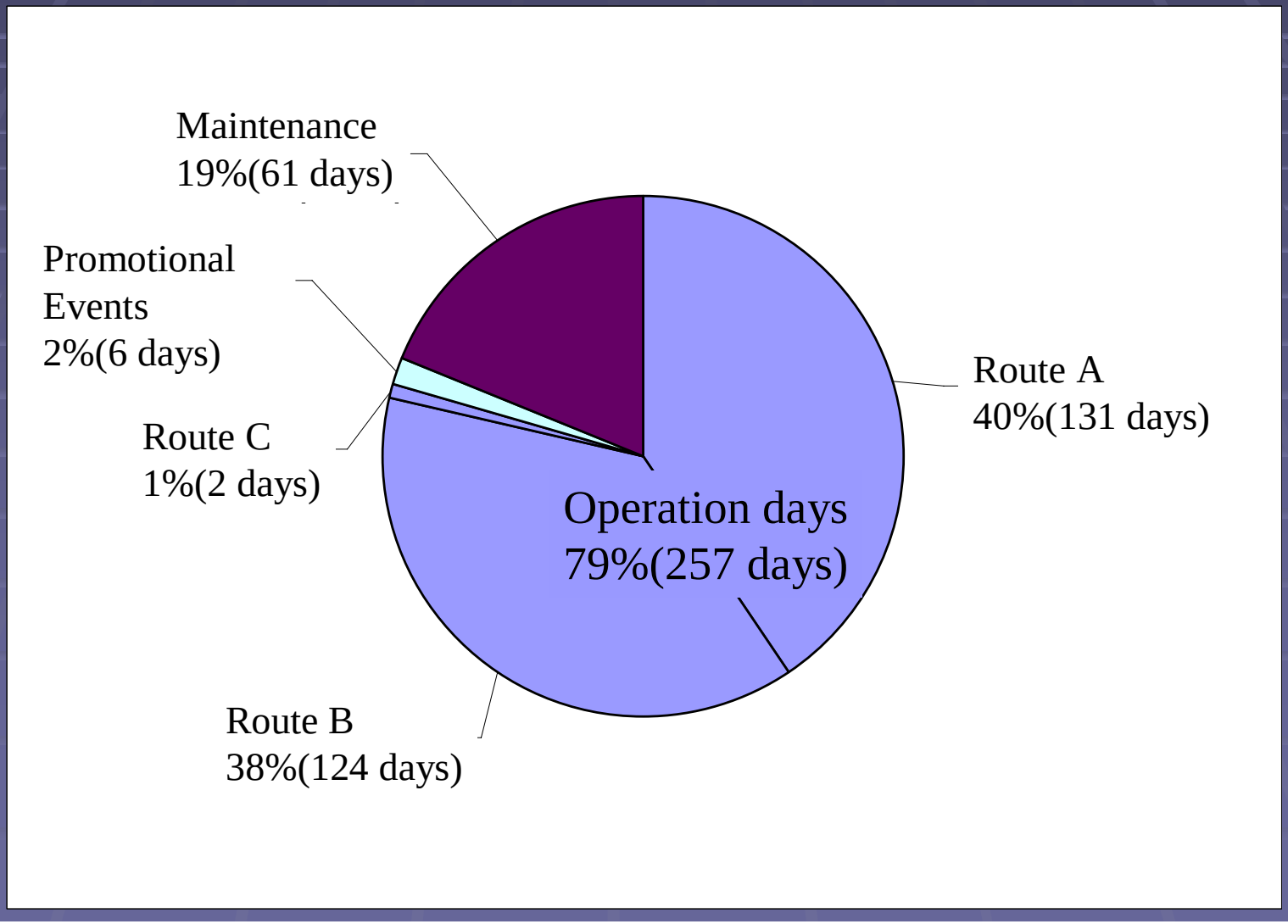
Comparison of Fuel Consumption



Diesel Bus
(Large-sized, non step type)
Average in Jan.2005
N:5
Driven by different drivers

Fuel Cell Bus
(Large-sized, non step type)
Average in Jan.2004
N:8
Driven by different drivers

Share of Operation Days



Public Reaction

The passenger survey

1．Purpose

Collect data of the fuel cell bus passengers' feeling
in order to promote fuel cell bus and to spread fuel cell bus service area.

2．Survey

1） Method： hand out questionnaires to passenger at the major bus stops.
Sheets were filled in and returned by postal mail.

2） Term ： January 18th ~ 19th , 24th ~ 28th 7 days

3) sample： Total distribution 473 Effective responses 272 (Response Ratio 63%)

Detail

	male				female					Total
	Stu-dent	Office worker	elderly	Others (Child)	Stu-dent	Office worker	House-wife	elderly	Others (Child)	
Number of Response	6	136	13	-	8	69	32	9	-	272
Ratio	2%	50%	5%	-	3%	25%	12%	3%	-	100%
Share of passenger (Estimated)	3%	44%	6%	2%	2%	22%	13%	4%	3%	100%

How did you find the “FC Bus”?

Total(N=272)

- Quiet 53%

- Environmentally-friendly 12%
- Effective to solve global-warming and environmental problems 4%
- No exhaust emission 3%
- Clean image 2%
- Friendly to human body 2%

- Smooth running/Less jolting 17%
- Smooth acceleration/deceleration (non-stage transmission) 6%

- Comfortable to ride on 14%
- Feel fine 2%

- It’s neat inside. 4%
- The direction board behind the driver’s seat is easy to read. 2%
- There’s little difference in level on the floor (barrier-free). 2%
- It’s larger than other buses. 2%
- Other comments related to the interior. 6%

- Powerful. 2%
- Has good acceleration. 1%

- Inside, don’t smell anything (like diesel fumes) 2%
- Don’t smell exhaust. 1%

Other positive comments 8%

- The seat is too hard. 8%
- It’s too small inside. 5%
- There are not many seats. 3%
- Rear seats need improvement. 2%
- It’s difficult to stand up from rear seats. 2%
- The difference in level onboard is not good. 2%
- Had difficulty grabbing the handhold../ There are no straps. 2%
- Other comments related to the interior equipment. 4%

- Starting and stopping are not smooth. 2%
- Feel bumps from the road. 1%
- Too slow. 0%

- No difference from ordinary buses. 3%

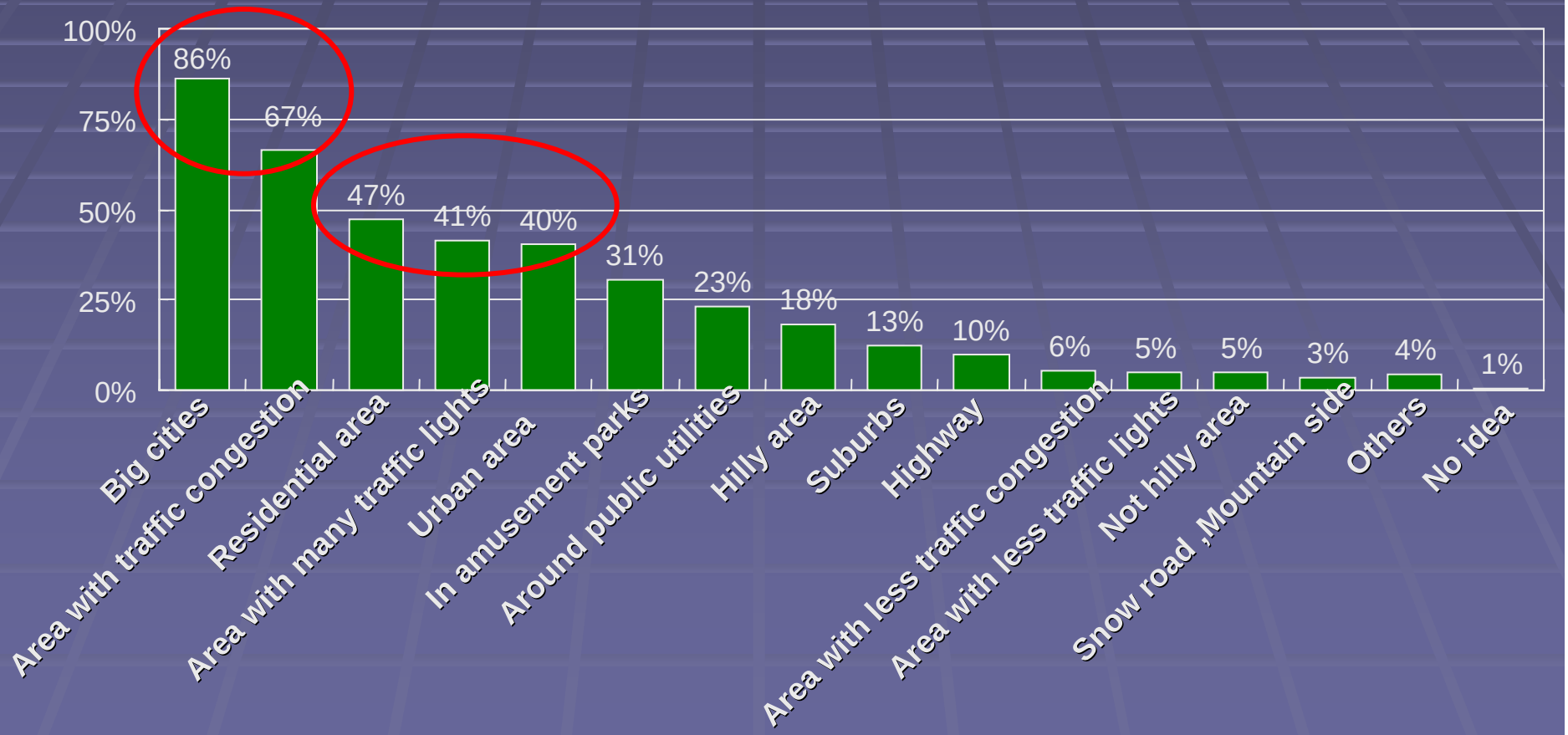
- Will take much purchase and maintenance costs. 2%

- Dangerous. Feel uneasy about safety. 1%

Other negative comments 1%

Expected area for FC bus operation

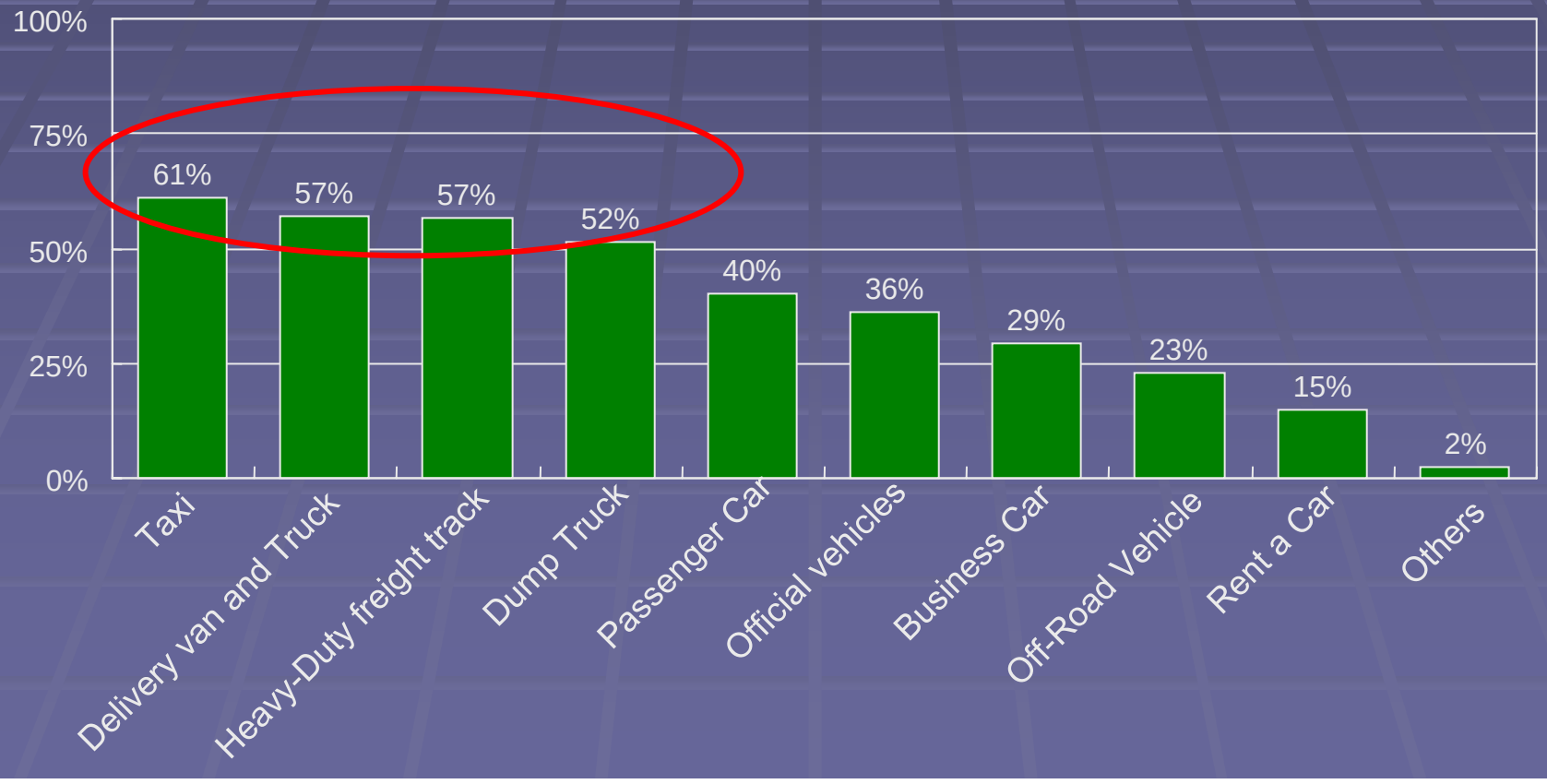
- Big cites (86%) and area with heavy traffic congestion (67%) were highly expected
- Residential area (47%) , area with many traffic lights (41%) and urban area (40%) come to the next



Expected field of Fuel Cell vehicle application other than Bus

Which type of vehicle is to be preferable to introduce and promote ?

- More than half people are hoping to promote Taxi and Truck as Fuel cell vehicle application.



Drivers Reaction

1．Purpose

To investigate the fuel cell bus drivability and low emission performance from the comments of fuel cell bus driver.

2．Survey

1）Method：Hand out questionnaire to bas driver

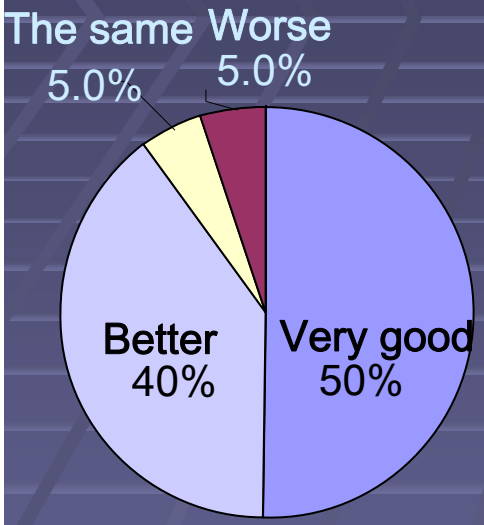
2）date：December 15th ,2003 ~ January 6th 2004

3）The number of driver：21

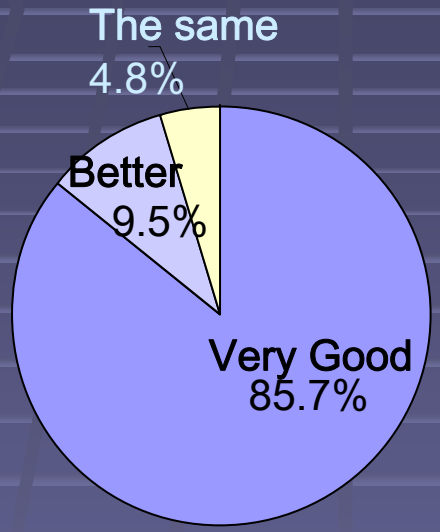
Questionnaire

- Impression to the fuel cell bus
- Evaluation of drivability and low emission performance
- Evaluation of noise and vibration
- Impression to the using fuel cell
- Total evaluation of Fuel Cell bus from driver's view

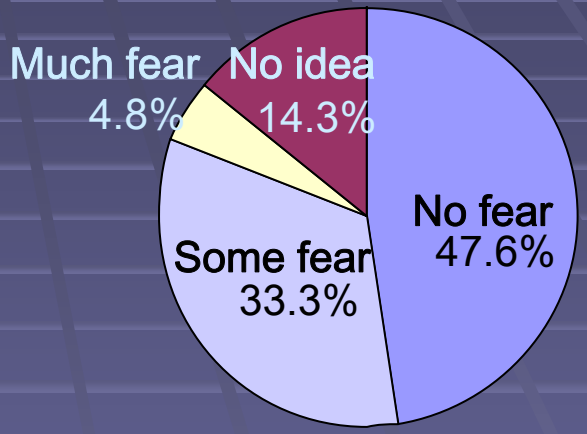
Results(1)



Total Impression



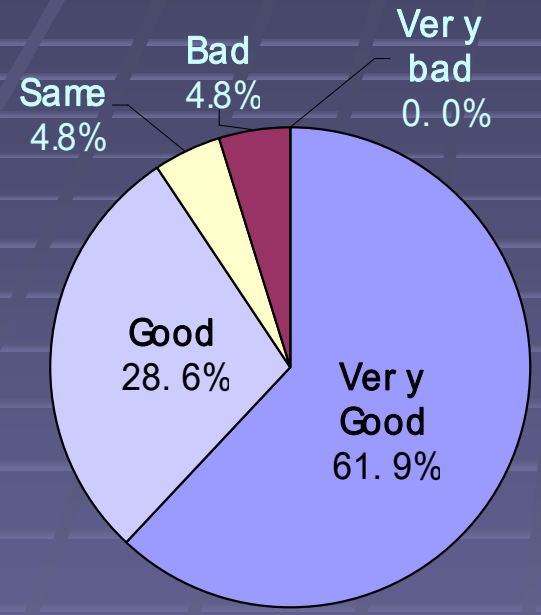
Acceleration



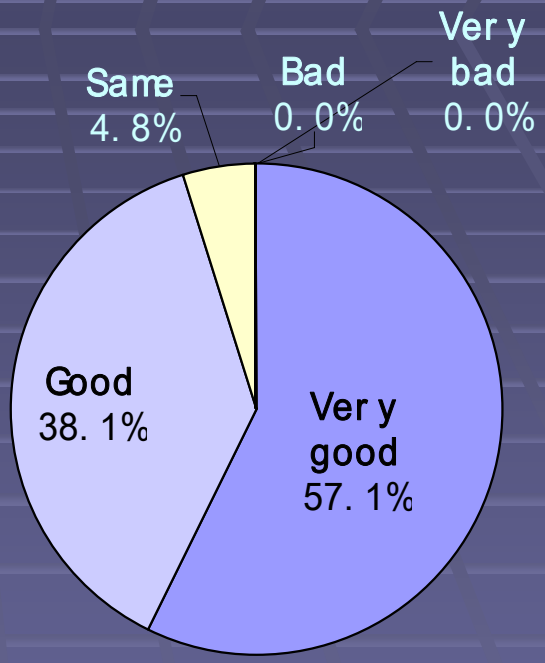
Concern about the safety of hydrogen fuel

- Almost all drivers expressed a favorable position.
- There is hardly becoming tired by driving because, acceleration is very smooth, and there is no shift-shock, vehicle response is excellent.
  It is felt that the acceleration feeling is especially good when going out of the rut.
- Currently, hydrogen fuel is not so common. Education of the safety of hydrogen fuel seems to be necessary.

Results(2)



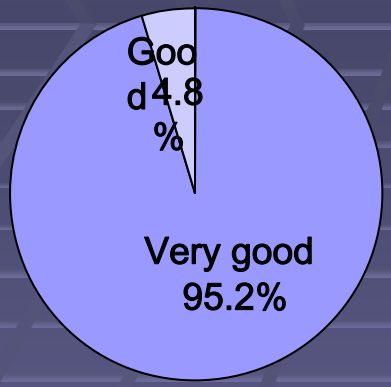
Startability



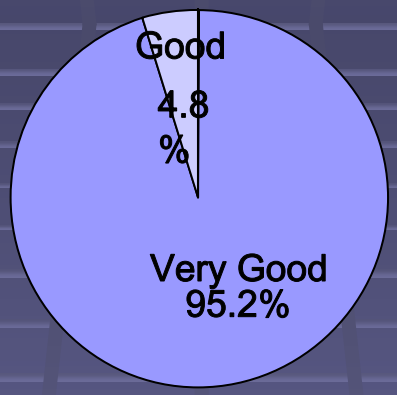
Driving performance on slopes

Results(3)

While the bus is stopping



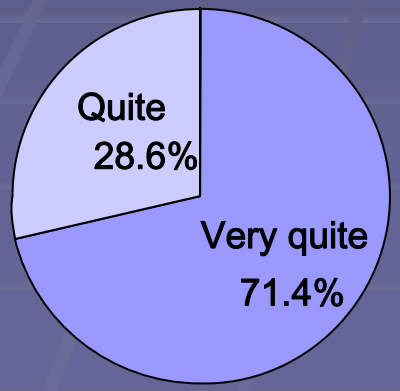
Vibration



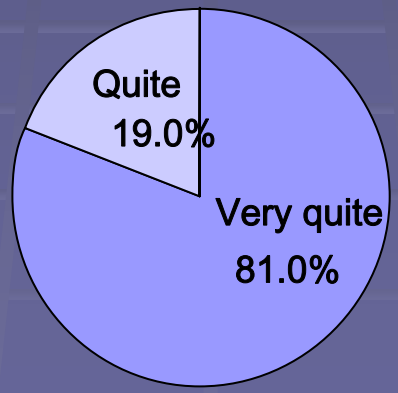
Noise

All driver expressed ‘good’ or ‘very good’ mark for vibration and noise.

While the bus is running



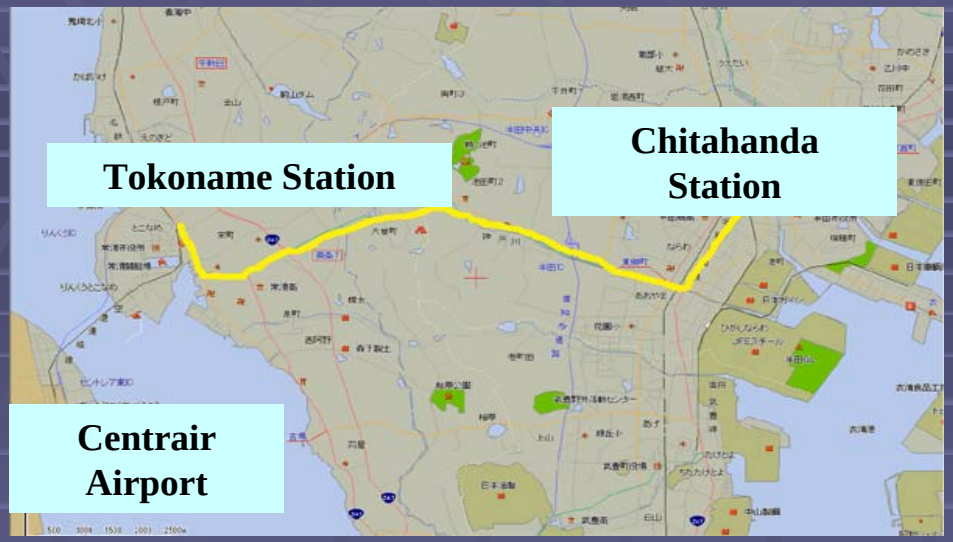
Vibration



Noise

The fuel cell bus is so quiet that senior passenger may not find the bus get started.

FC Bus Demonstration at Centrair, 2005-2006



<Objectives>

- Collect data relating to safety standards for FC bus
- To raise public awareness regarding FC bus
- sending messages to promote FC buses

In cooperation with Toyota Motors Corporation, Hino Motors and Japan Hydrogen & Fuel Cell demonstration project

Summary

- Demonstration study for Fuel Cell bus in service

The results obtained are as follows;

① Fuel consumption data on public service operation

② Evaluation by Passengers

③ Evaluation by Drivers

④ Survey data of vehicle inspection and maintenance