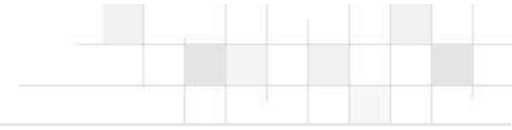


Development of New Hybrid City Bus



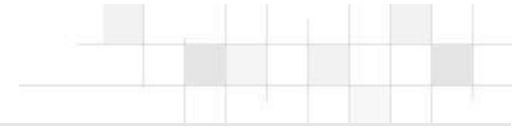
Atsushi Ohshima
Hino Motors, Ltd.
JAPAN

Contents



1. Background
2. Development Goal
3. Development Approaches
4. Development Contents
5. Results
6. Conclusion

Contents



1. Background

2. Development Goal

3. Development Approaches

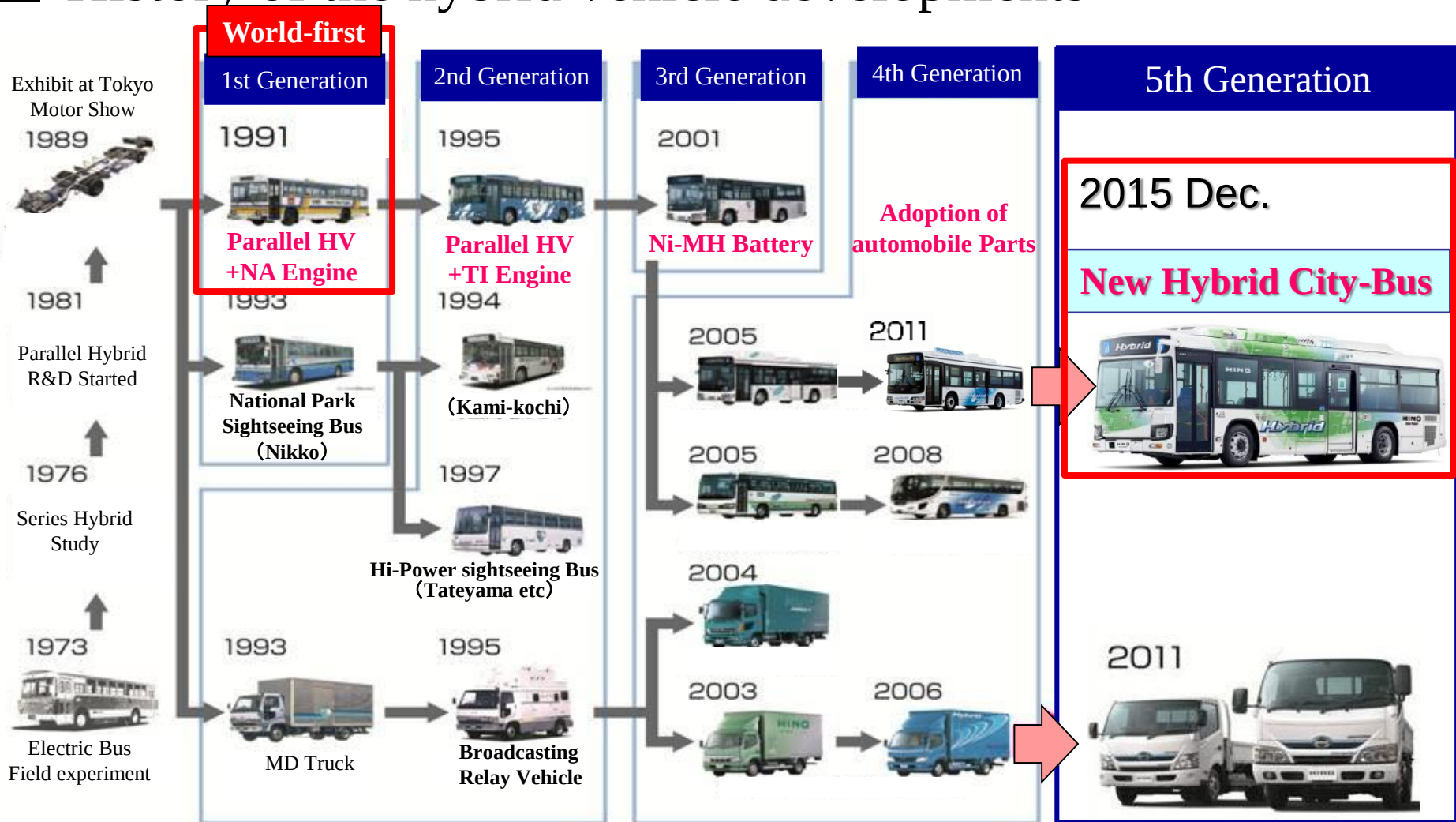
4. Development Contents

5. Results

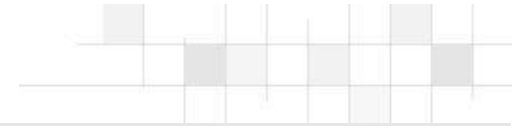
6. Conclusion

1. Background

History of the hybrid vehicle developments

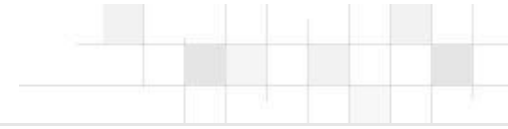


Contents



1. Background
- 2. Development Goal**
3. Development Approaches
4. Development Contents
5. Results
6. Conclusion

2. Development Goal



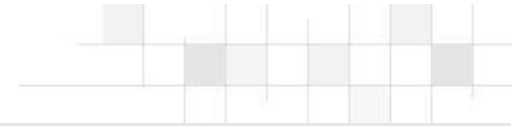
Fuel Economy Improvement:

Over 40% as compared to

※The unit is km/L

conventional diesel buses

Contents



1. Background
2. Development Goal
- 3. Development Approaches**
4. Development Contents
5. Results
6. Conclusion

3. Development Approaches

■ Development of optimal powertrain system for city bus

Today's focus

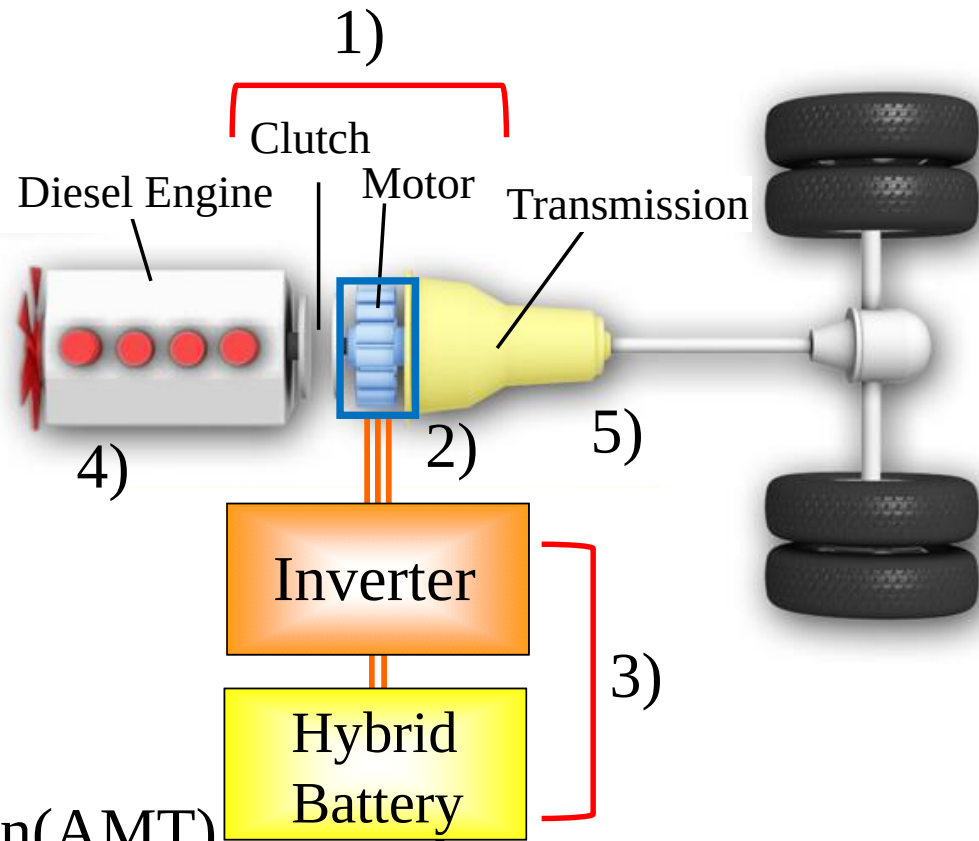
1) Change of powertrain layout

2) Development
of new hybrid units

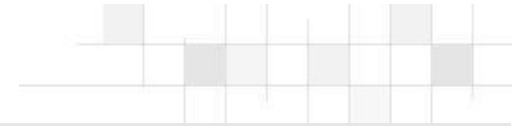
3) Optimization of hybrid control

4) Engine downsizing

5) Automated Manual Transmission(AMT)
adopting



Contents

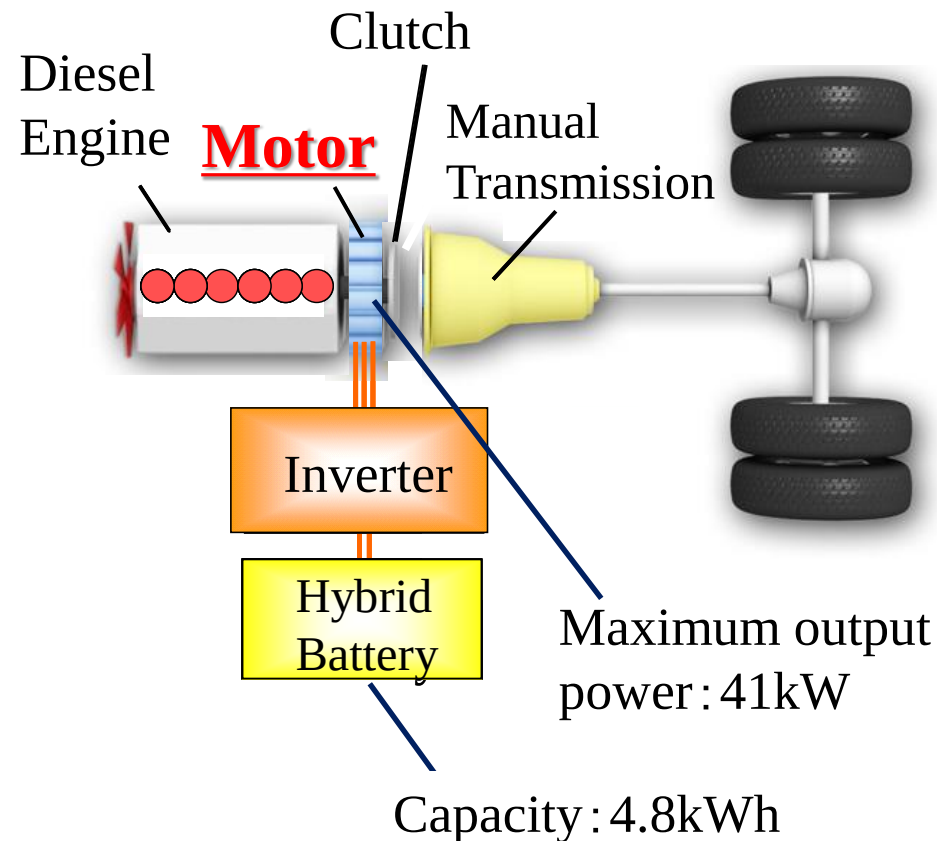


1. Background
2. Development Goal
3. Development Approaches
- 4. Development Contents**
5. Results
6. Conclusion

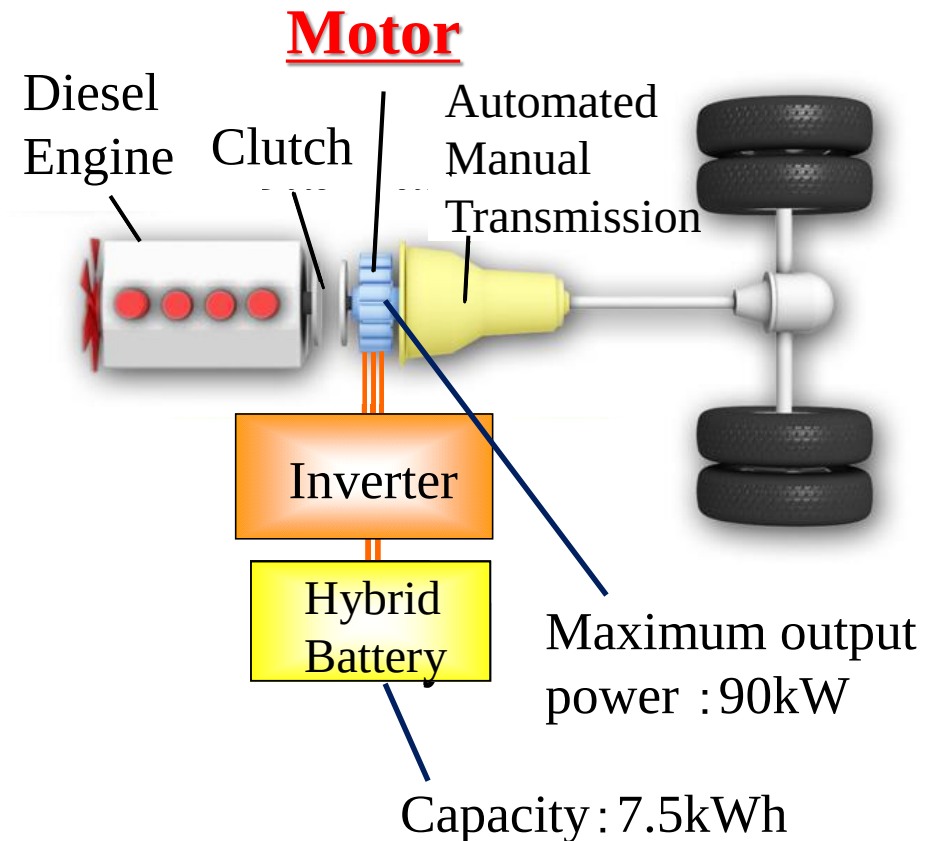
4. Development Contents

■ Improvement of hybrid system

【Previous Model】

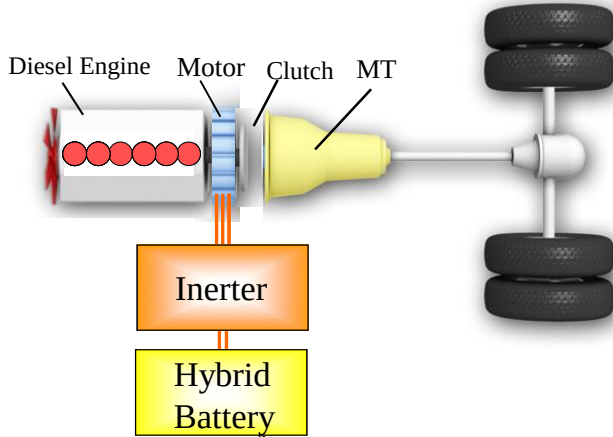
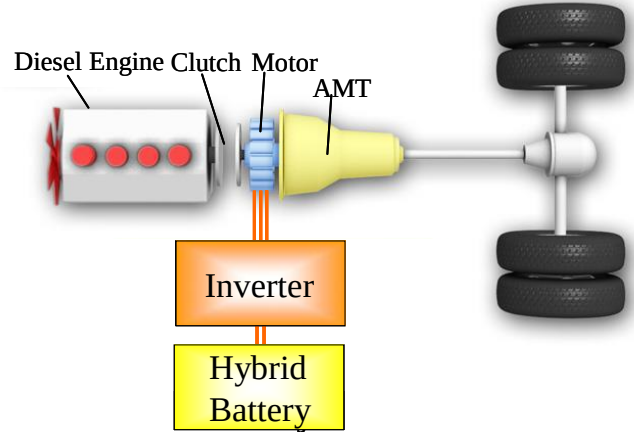


【New Model】

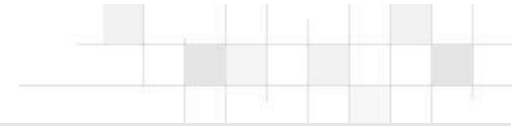


4. Development Contents

■ Vehicle specifications

	Previous Model	New Model
Engine	6-cylinder inline(7.684L)	4-cylinder inline (5.123L)
Transmission	Manual Transmiion(5speed)	Automated Manual Transmission (6speed)
Vehicle Size(L×W×H) mm	10,525×2,490×3,285	10,555×2,485×3,105
Gross Vehicle Weight	15,280kg	14,365kg
Hybrid System		
Motor	Induction Motor (41kW)	Permanent Magnet Synchronous Motor (90kW)
Battery	Ni-MH(4.8kWh)	Ni-MH(7.5kWh)

4. Development Contents



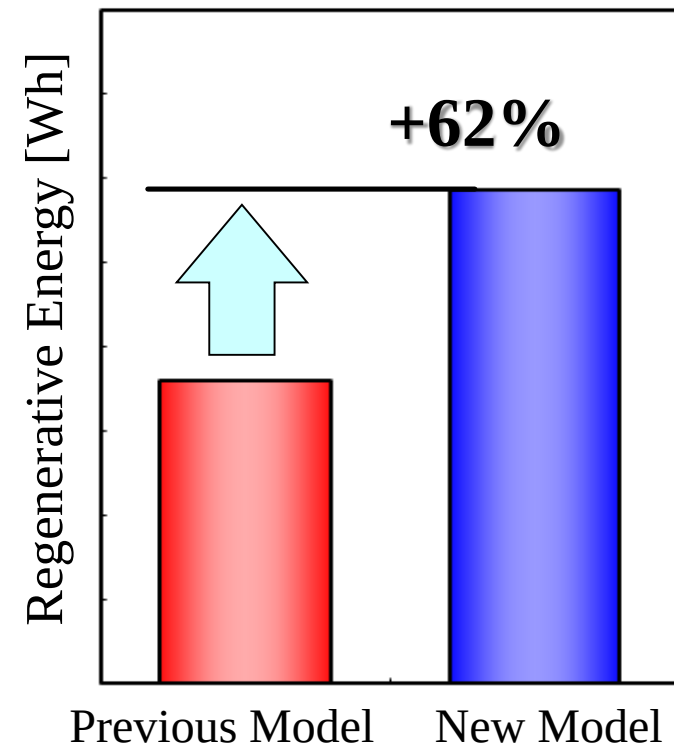
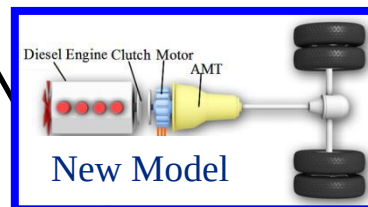
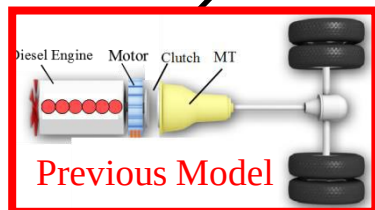
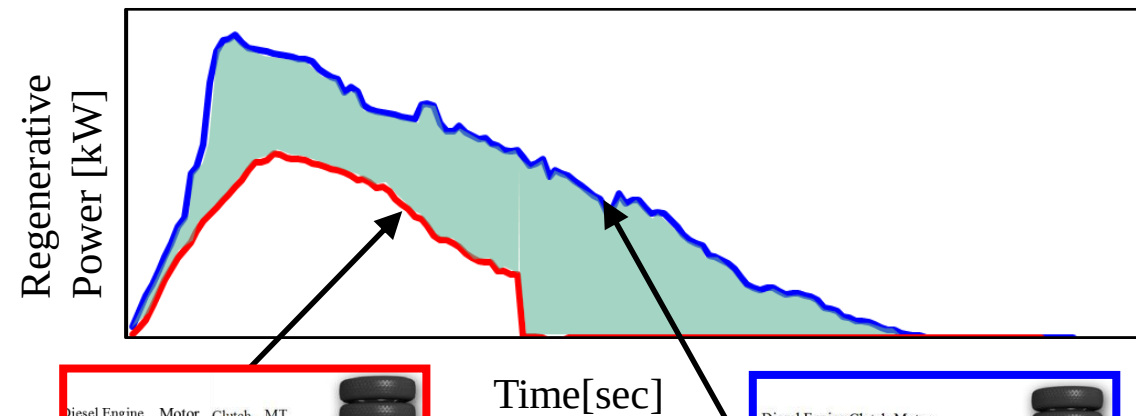
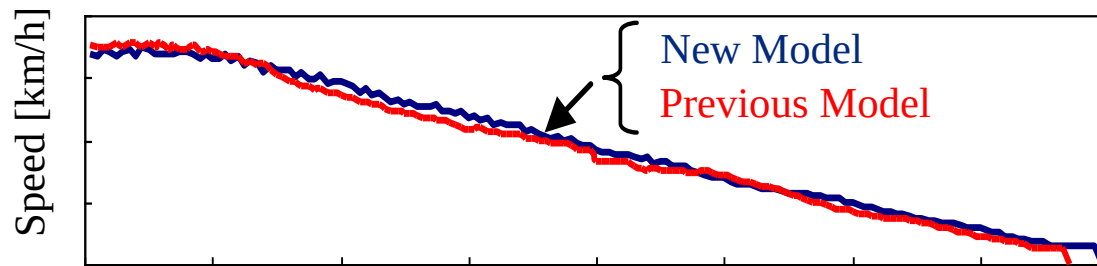
The effect of the improvement technologies

Increasing Regenerative Energy

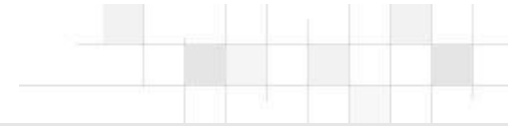
4. Development Contents

■ Increasing regenerative energy

- Comparison of the regenerative energy of previous model and new model



4. Development Contents



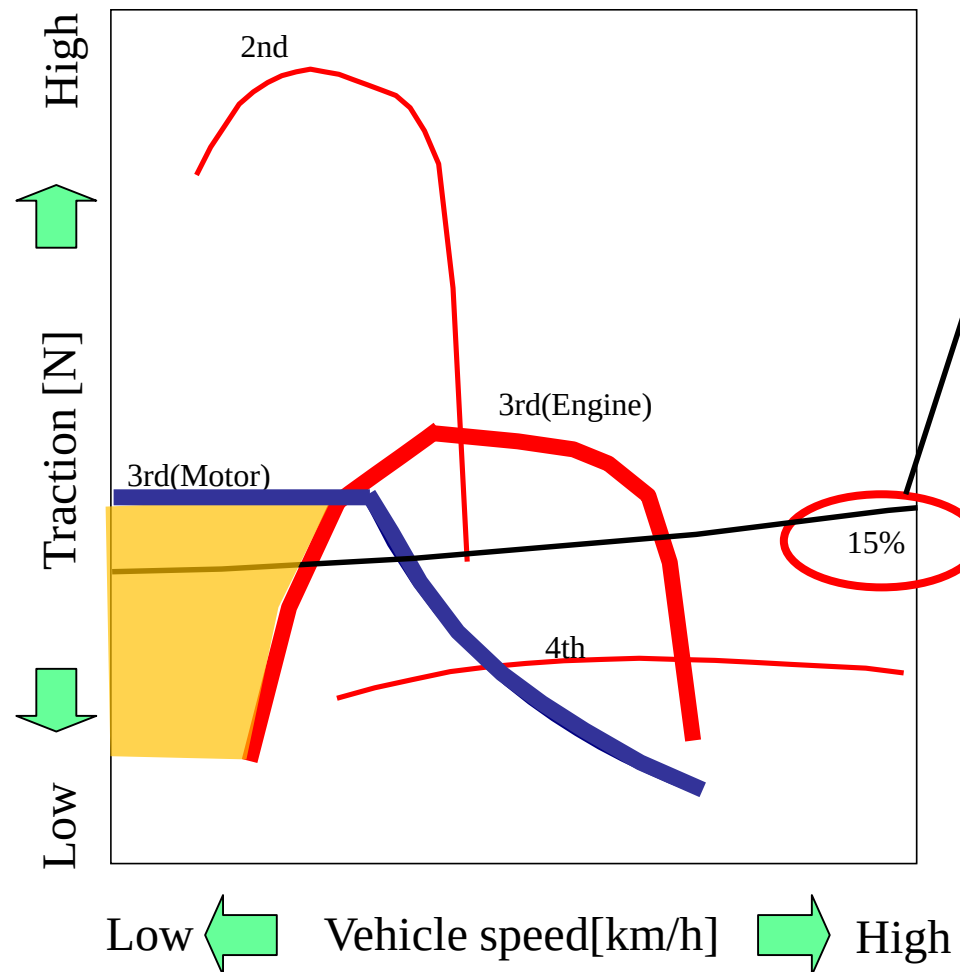
The effect of the improvement technologies

Examining how to use
this regenerative energy efficiently

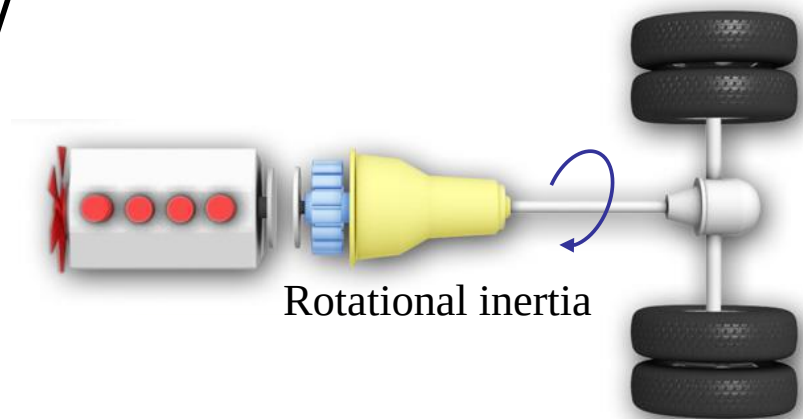
4. Development Contents

■ Examining how to use this regenerative energy efficiently

▪ 3rd Motor Starting



The slope of the route of a conventional city bus is less than 15%.

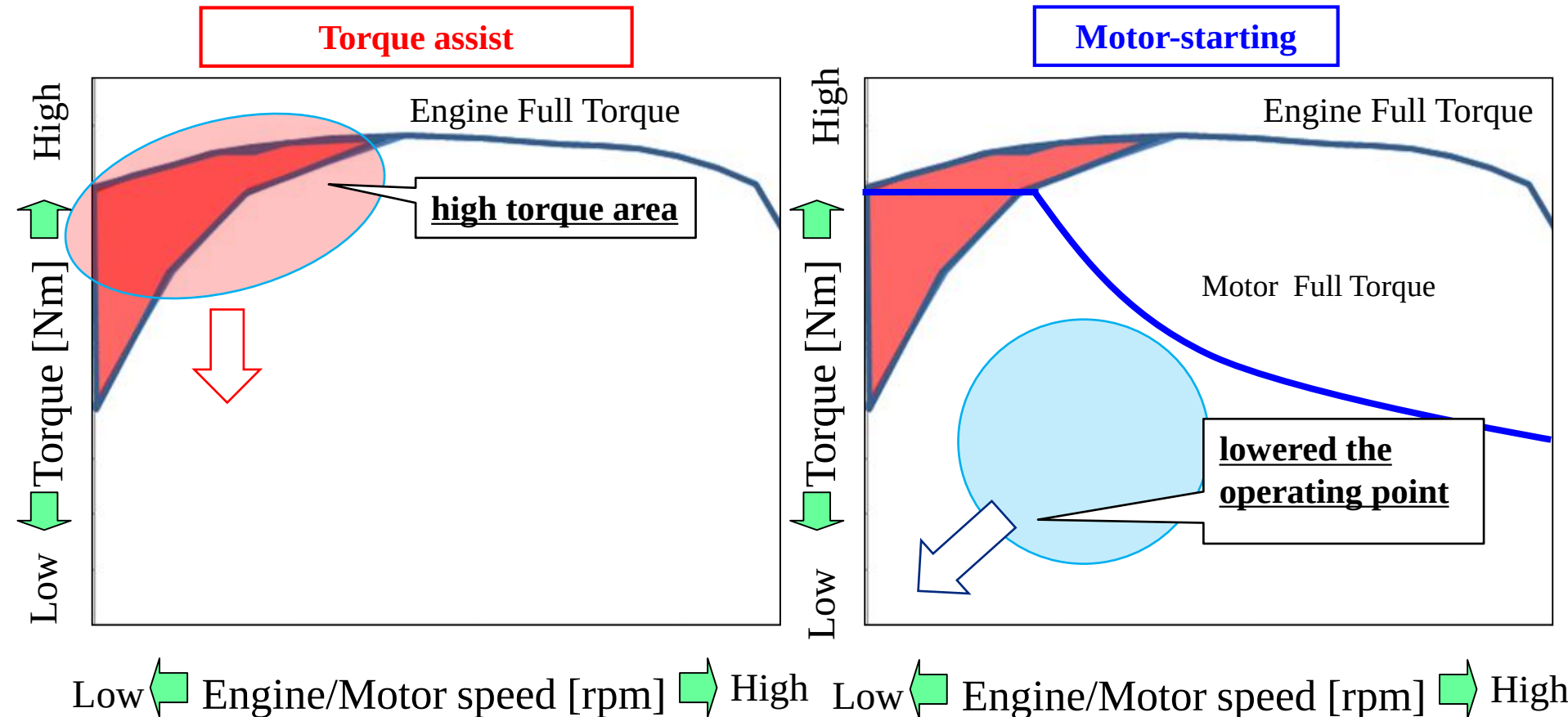


Difference of rotational inertia of 2nd and 3rd

$$\Delta W_{2nd-3rd} \cong 1000\text{kg}$$

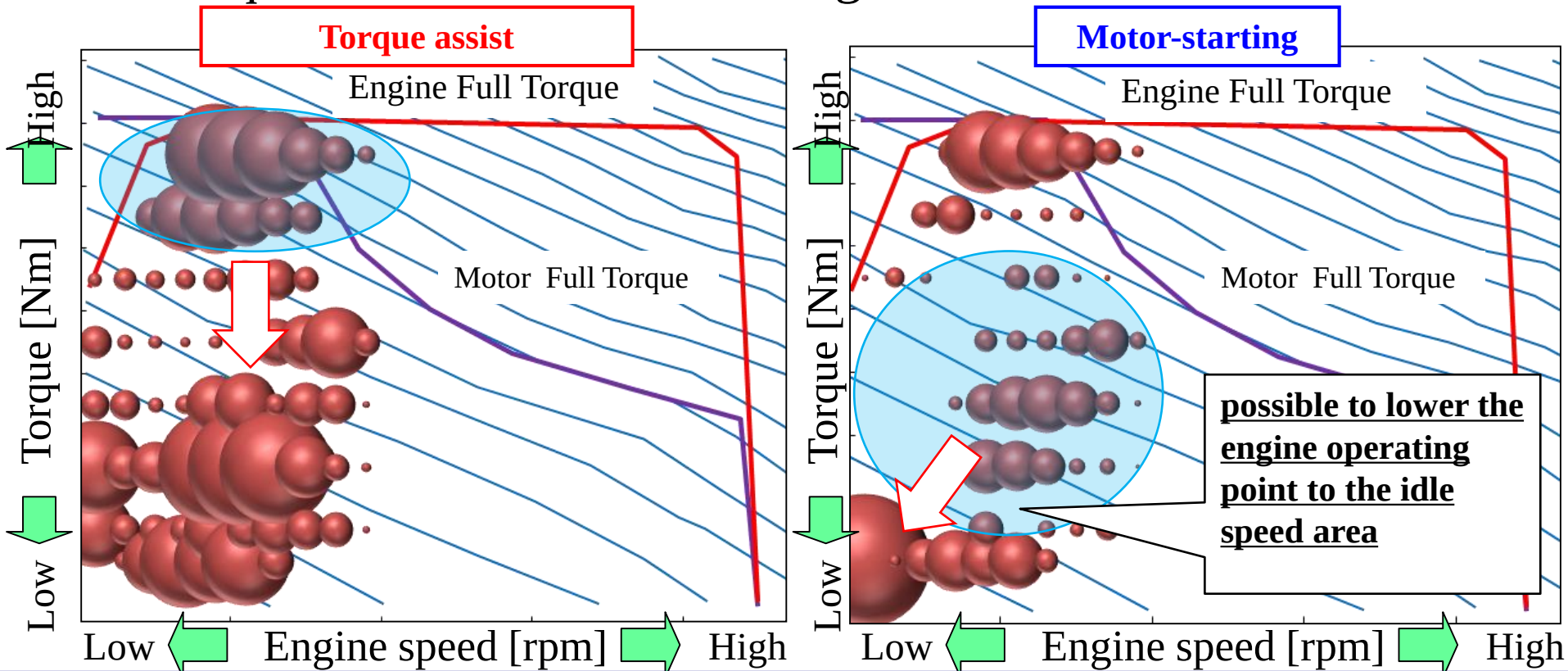
4. Development Contents

- Examining how to use this regenerative energy efficiently
 - Aim of Torque assist and Motor starting



4. Development Contents

- Examining how to use this regenerative energy efficiently
 - Comparison of the engine operating point of Torque assist and Motor starting



Motor starting reduce fuel consumption by **10%** compared with torque assist starting.

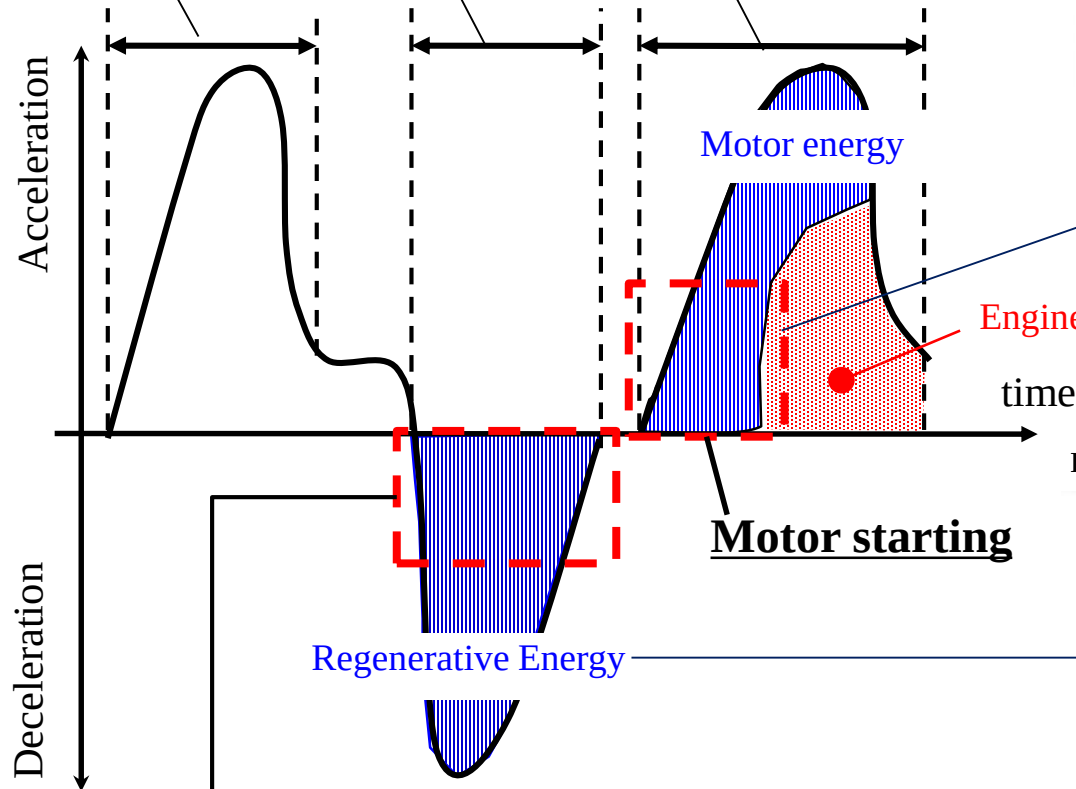
4. Development Contents

■ New hybrid system

Start • Acceleration

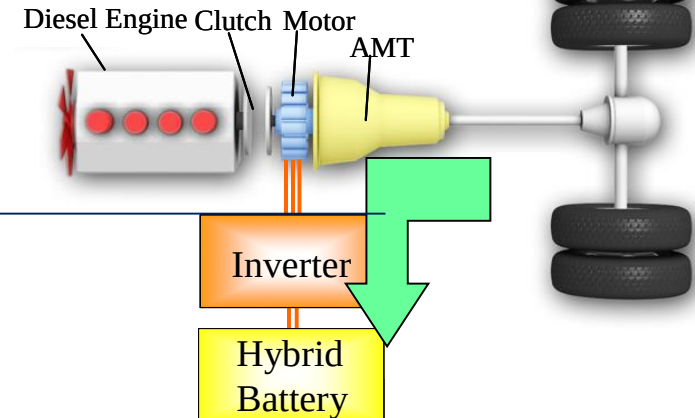
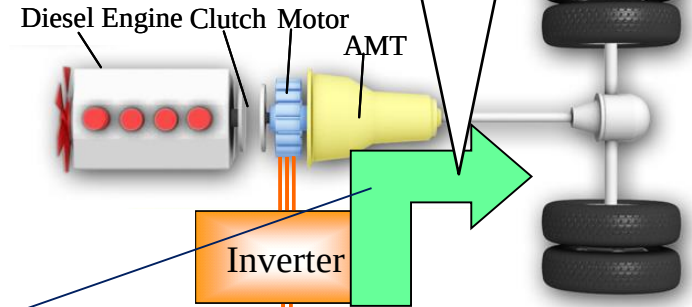
Deceleration

Start • Acceleration



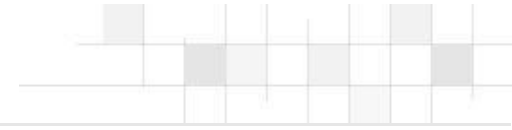
Changing the powertrain layout

start only by the motor with 3rd shift.



Achieved Increasing Regenerative Energy and Motor Energy

Contents

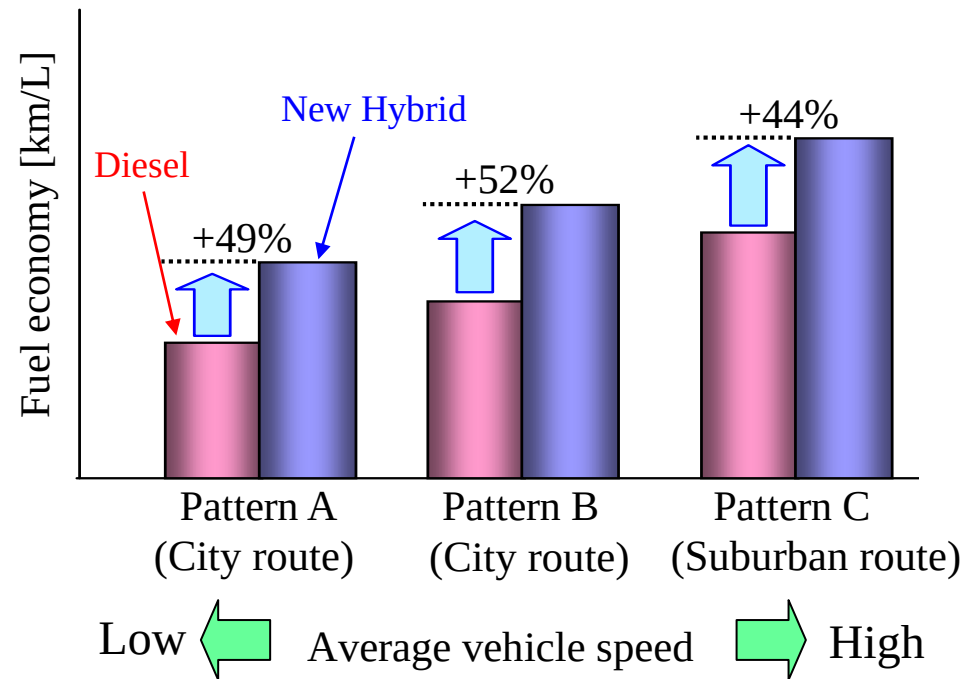


1. Background
2. Development Goal
3. Development Approaches
4. Development Contents
- 5. Results**
6. Conclusion

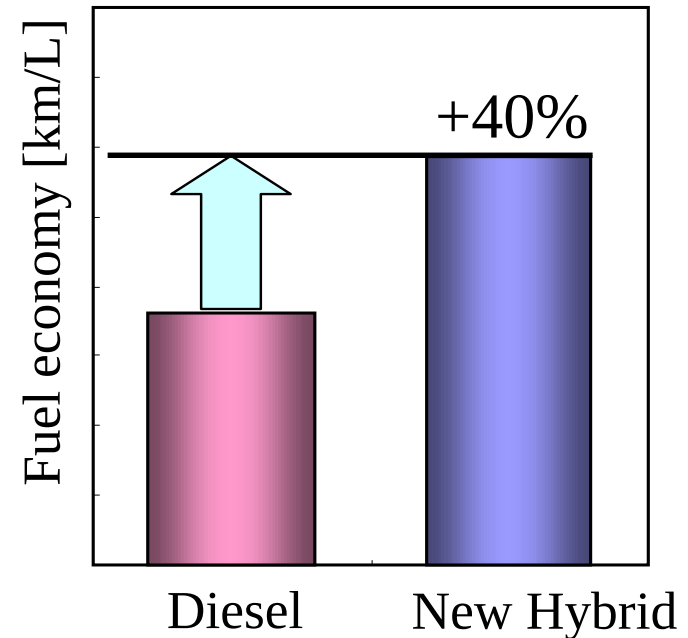
5. Results

■ Fuel economy improvement results

In-house evaluation tests

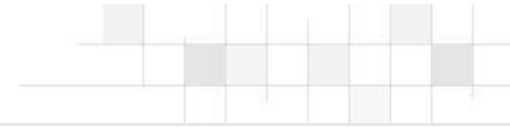


Demonstration test at users



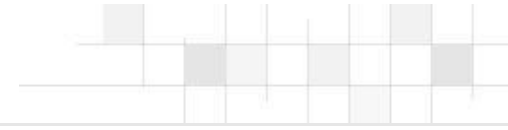
Achieved Fuel Economy Improvement ; **+40%**

Contents

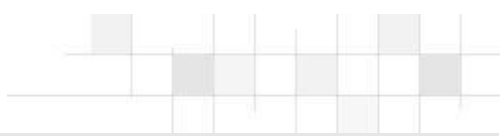


1. Background
2. Development Goal
3. Development Approaches
4. Development Contents
5. Results
6. Conclusion

6. Conclusion



We achieved our development goal,
40% fuel economy improvement both in-house evaluation and
use's demo by innovating hybrid system and control in new
hybrid city bus.



Thank you all for your attention!