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SUSTAINABLE WINTER SERVICE FOR ROAD USERS

The Development of Snow Removal Machinery for Optimizing Sidewalk Snow Removal

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●Characteristics of Snow-Falling Cold Regions

- Approximately 60% of Japan consists of snow-falling cold regions
- 28 million people live in these areas, accounting for 20% of the entire population
- Cities in the regions range in polulation from several hundred thousand to over one million
- Residents are more dependent on automobiles than residents in other regions.

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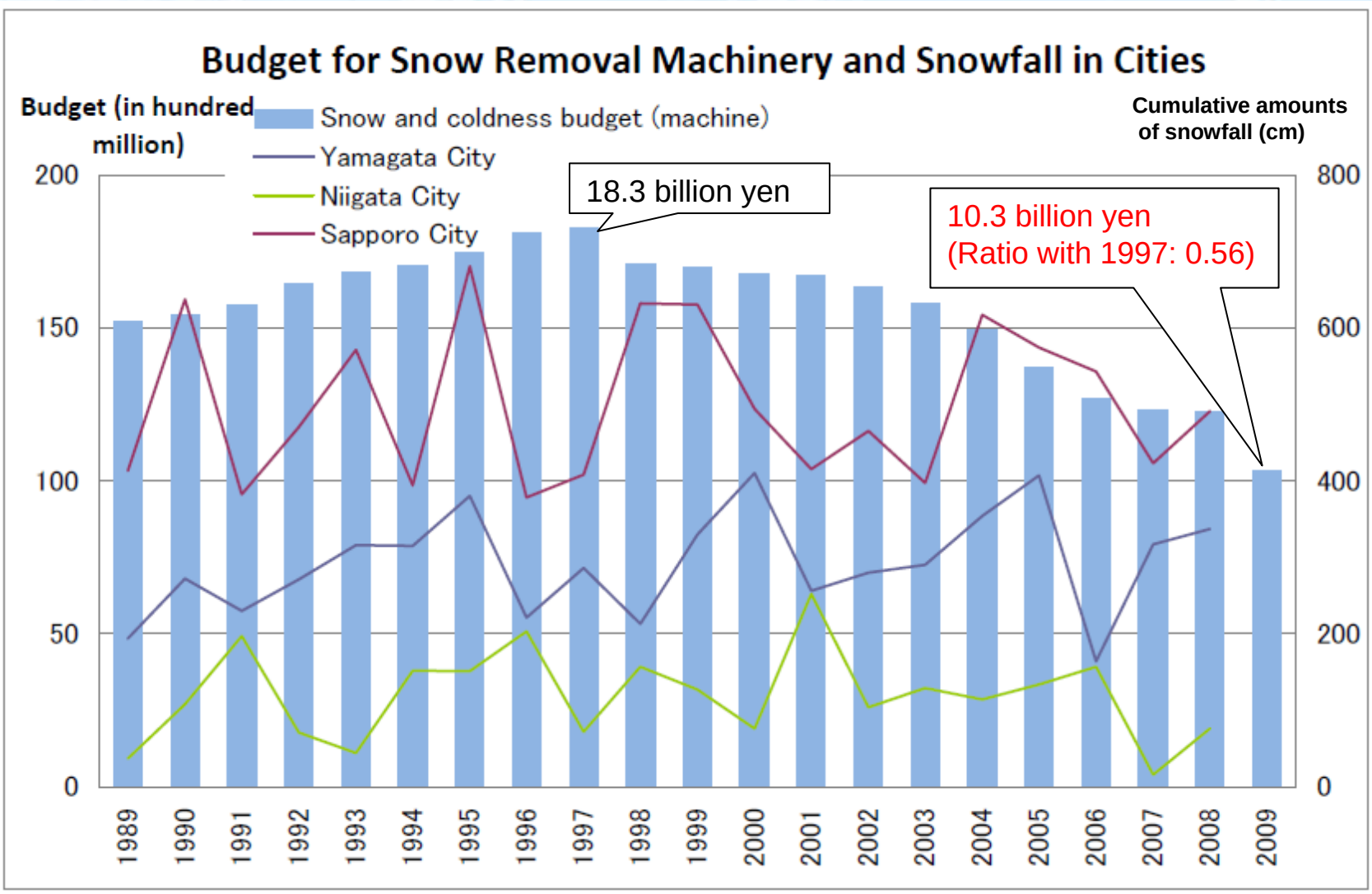
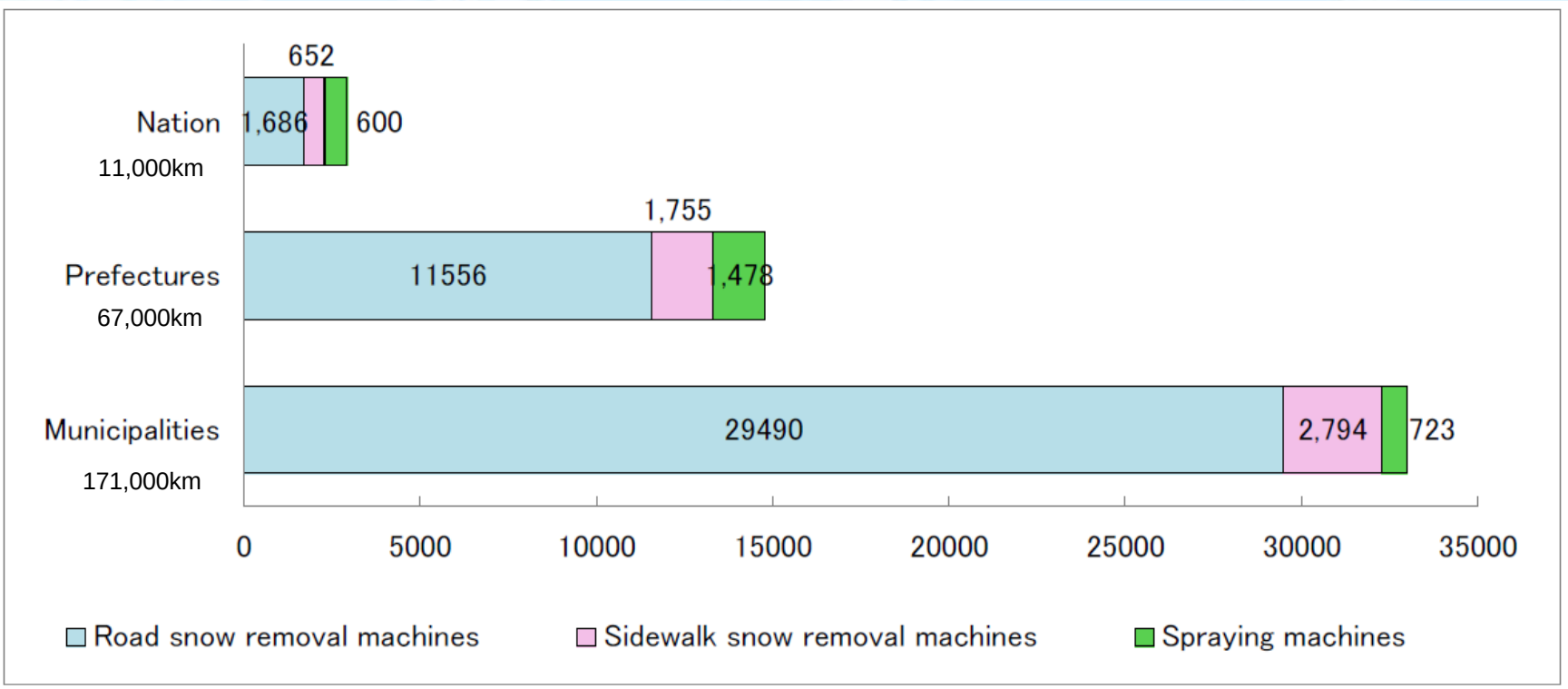
●Budget for Snow-Removal Machinery



●The Status of the Deployment of Snow Removal Machinery in Japan



	Snow removing length (in 1000km)	No. of deployed units (Ratio)
Road snow removal machines	250	42,732 (84%)
Sidewalk snow removal machines	32	5,149 (10%)
Spraying machines	51	2,853 (6%)
Total		50,734 (100%)

●Sidewalk Snow Removal in Japan

Sidewalk snow removal

- **Mechanized snow removal**
  - **Riding type**
  - **Walk behind type**
- Manual snow removal
- Snow melting machinery
- Snow-flowing gutter

No-spraying snow melting machinery

Snow-flowing gutter

* Because of the consideration in cost aspect, snow-removal is mainly carried out by means of machinery.

●Sidewalk Snow Removal Work in Japan

.1956: "Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts" was enacted

The law to provide the organized budget for road snow-removal was enacted

.1977: Sidewalk snow removal (trial snow-removal) was started in some areas

Dedicated snow-removal equipment was developed and the total length of snow-removal was extended

.2003 and on: A governmental policy was set to maintain the deployment level of snow removal machinery at the present standard

The budget has decreased year by year to 57% of its peak size

The development of sidewalk snow removal machinery with the emphasis on safety, work efficiency, and work cost

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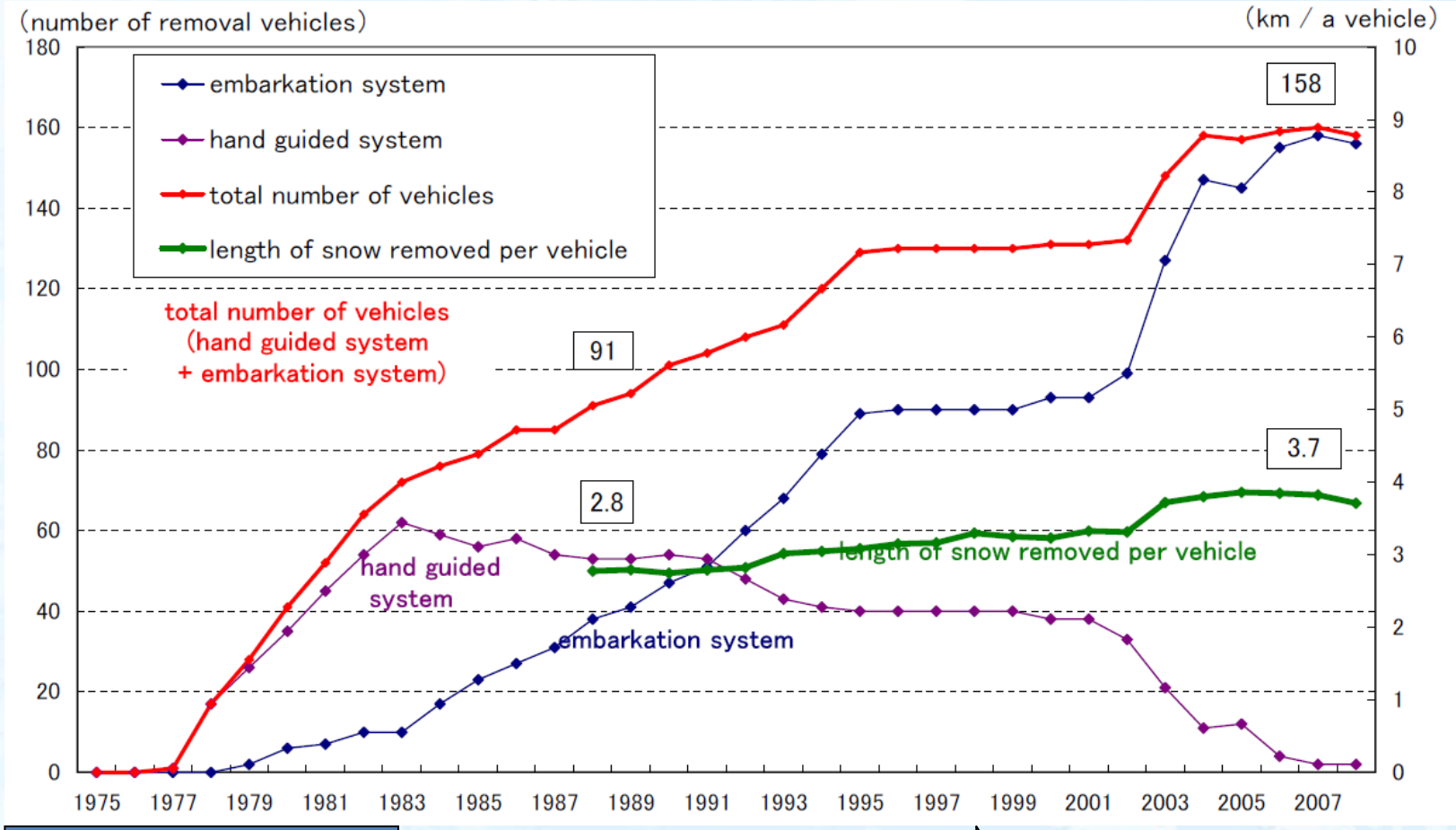
The Goals of Sidewalk Snow Removal

- To ensure pedestrian safety
- To create an optimal width of clear sidewalk as dictated by the amount of pedestrian use and the actual sidewalk width
- To avoid any sidewalk blockages caused by snowfall or roadway snow removal
- To allow for removal of snow from over-filled snow drift zones
- To complete snow removal operations before the morning rush hour

●The Transition of Sidewalk Snow Removal Machinery

The Number of Sidewalk Snow Removal Machines in Each Fiscal Year (Hokuriku)



Snow-removal length per piece of machinery

1988

2.8 km/unit

2007

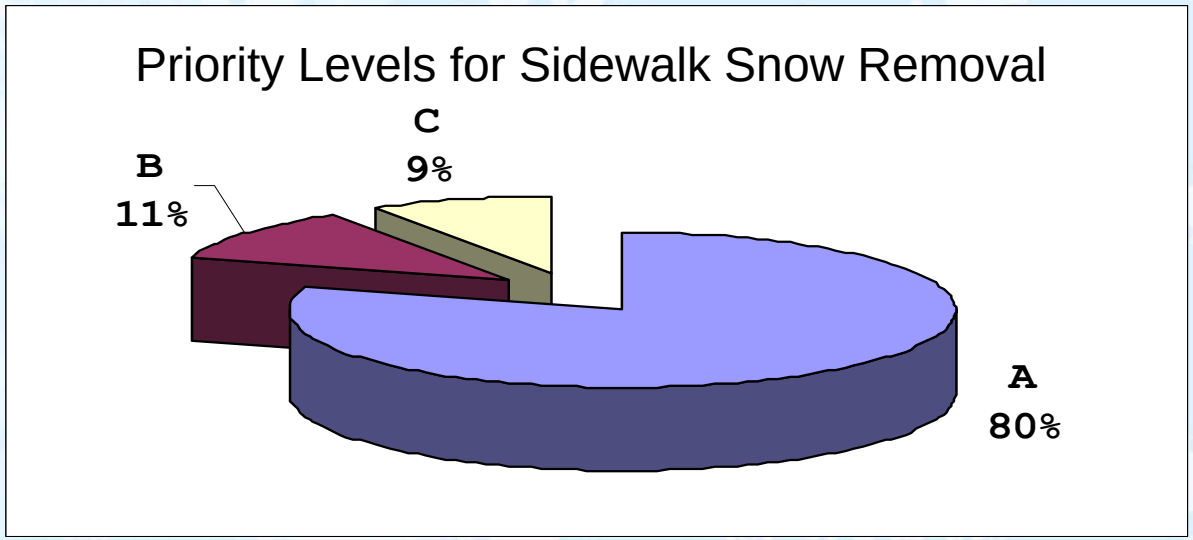
3.7 km/unit

The snow-removal length per unit has been improved by efficient allocation

●Priority Levels of Sidewalk Snow-Removal

Targets for Sidewalk Snow Removal

Target rank condition	A	B	C
Sidewalk utilization level	Number of pedestrians is 100/day or more, or the number of students is 40/day or more	Route to a kindergarten or school	Zone important for traffic safety
Weather condition	The zone where the average yearly cumulative snowfall is 2 meters or more within the past 5 years		
Local community	Cooperative to snow removal Requesting snow removal		
Period for snow removal	Snow removal before commuting to/from school	Snow removal after continuous snowfall	Snow removal during snow melting period



●Targets of Sidewalk Snow Removal by Snow-Removal Machinery

- Reduction of operational costs
  - **Improvement of operational speed by ease of use**
  - **Reduction of downtime caused by snow clogging, etc.**
- Increasing public dependence on snow removal due to the dwindling birthrate and aging
  - **Demand for safe snow-removal machinery easily used by local volunteer workers**
- Shift to barrier-free sidewalks to reduce slip and fall accidents caused by narrowing sidewalk widths and frozen sidewalks
  - **Securing comfortable walking space within sidewalks during the winter period**
  - **Deployment of machinery to secure sidewalk width and surfaces suitable for walking**
- Safety for machine operators and citizens
  - **Safety measures to prevent operator injury**
  - **Safety measures to prevent pedestrian injury during snow removal**

●Development Projects in Recent Years

□Development for improving the efficiency of sidewalk snow removal

Operational efficiency improved by 30%

□Development for improving the safety of sidewalk snow removal

Avoiding any rolling-in accident

□A typical small snow removal machine

Reason of the necessity of dedicated sidewalk snow removal machinery:

.Snow-removal capacity (t/h) is low and snow-removing cost is high

.Not capable of removing hard-packed snow on sidewalks

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●Development for Improving the Efficiency of Sidewalk Snow Removal

- Obstacles against more efficient operations -

- Factors concerning the technical proficiency of machine operators
- Obstacles for the machinery
- Factors which hinder job performance

Development goals

Simplified and semi-automatic operational system

Reduction of operational cost by 20%

●Streamlining of Operational Efficiency

Snow clogging prevention mechanism

The case in which the control is not made

The case to control speed by monitoring the rotation of the blower

To control the vehicle running with monitoring the rotation of the blower

Amount of snow over the blower at discharge capacity

Overload condition occurs

Snow removal machine stops

No snow clogging occurs

Overload condition is solved

Snow removal machine restarts

No control (Snow clogging is removed manually)

Amount of snow over the blower at discharge capacity

Overload condition occurs

Snow removal machine stops

Snow clogging removal (5 to 10 minutes needed)

Overload condition is solved

Snow removal machine restarts

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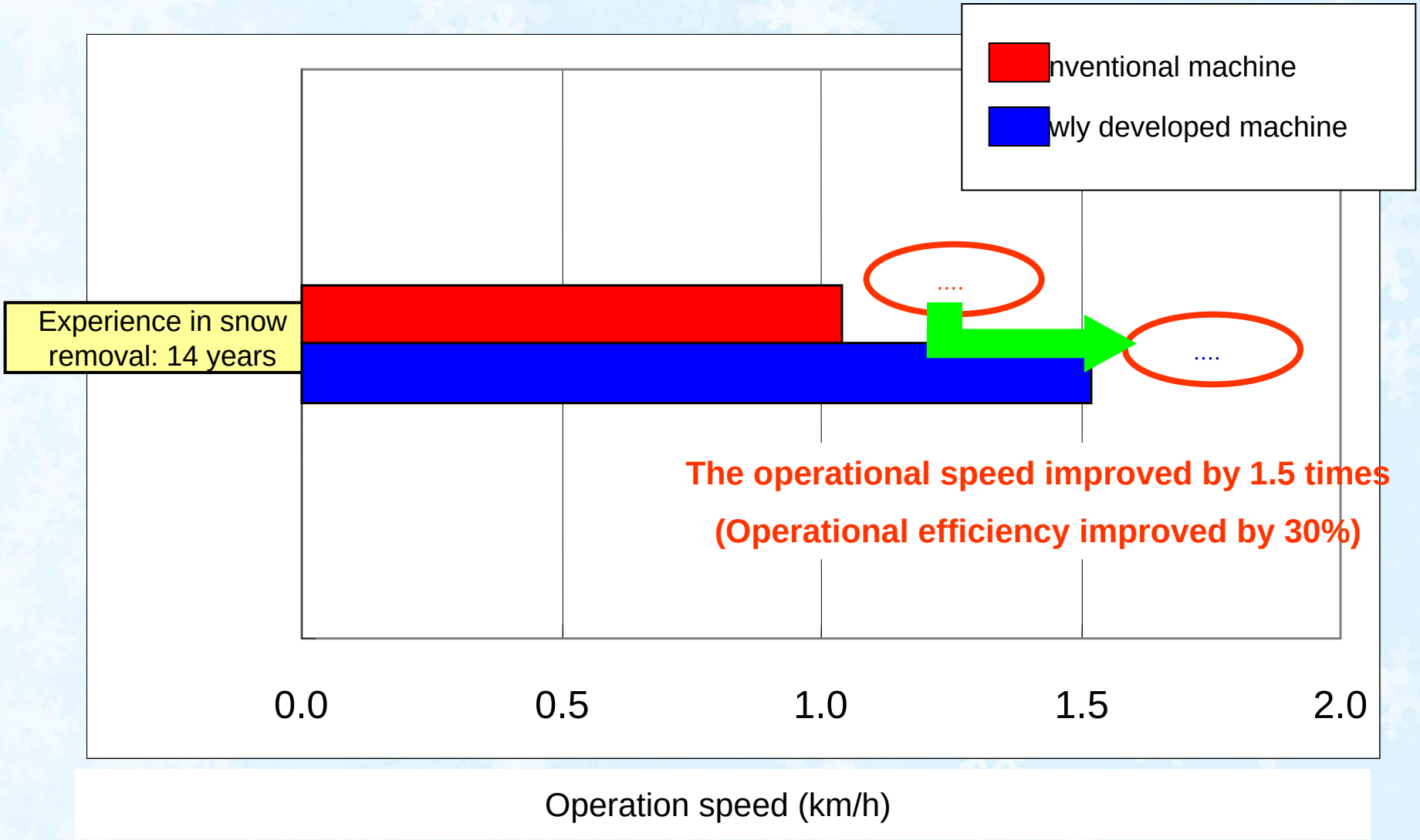
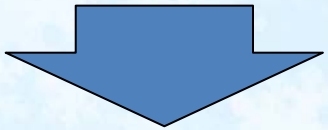
●Improvement in Operational Speed



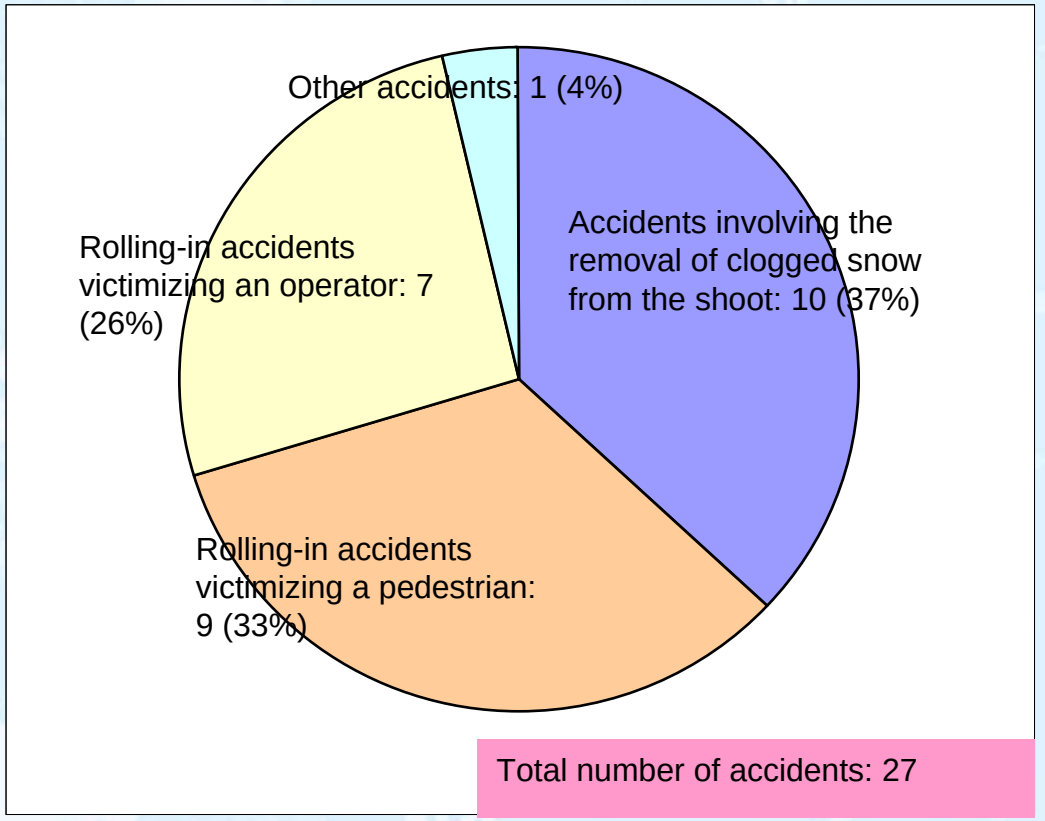
●Risk Factors in Sidewalk Snow Removal

- Structural factors of snow-removal machinery
  - Large opening in the front side of the auger
- Factor in snow removal work
  - Necessity to operate a lot of operation levers



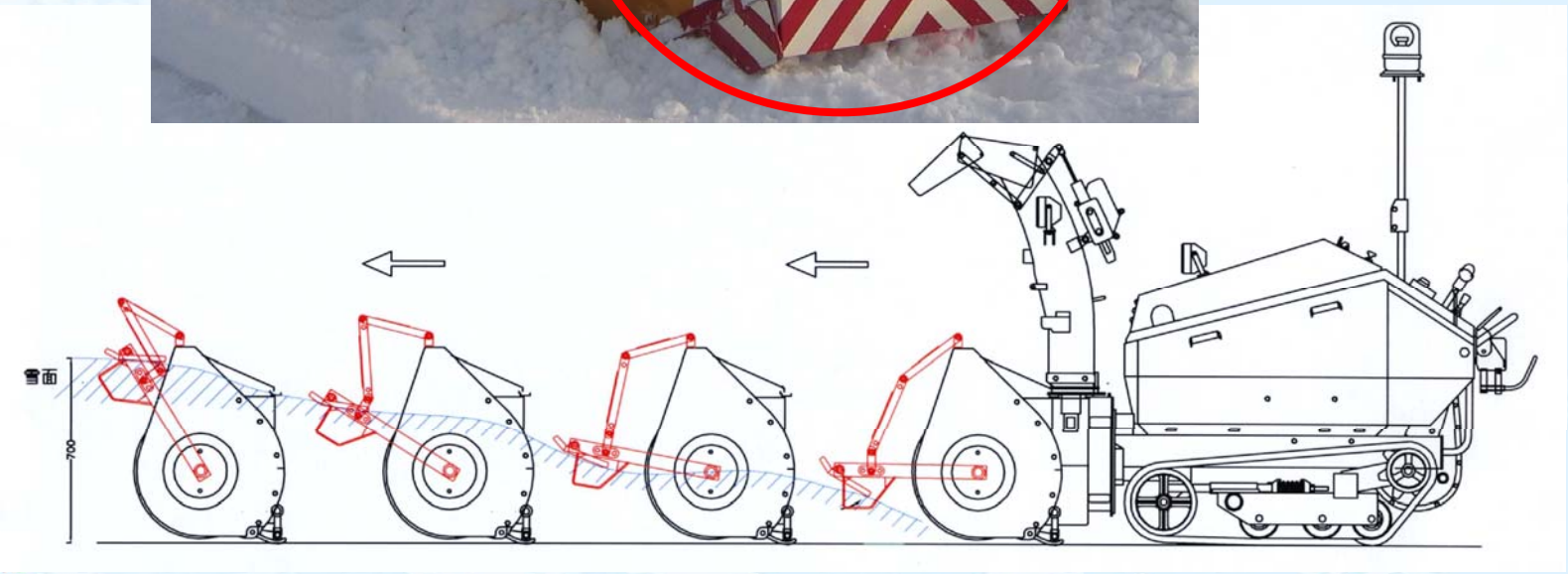
- Development target -

- New development of safety mechanism
  - Development of safety cover in the front side of the auger
  - Simplification of operation by integrating operation levers



Ratio of accident cases occurred during operations using sidewalk snow removal machines (2003 . 2004)

●Movement of the auger safety protector



●Operating State of Safety Protector

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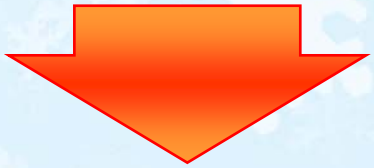
●Effect of Safety Improvement

- The auger safety protector is able to cover more than 70% of the frontal opening.
- The integration of operational levers leads to the secure safety confirmation of surroundings.



It becomes possible to avoid any occurrence of accidents by sidewalk snow-removal machinery without lowering the capacity for snow-removal

●Conclusion

Promotes the reduction of the cost of public work projects by thorough cost reexamination

Reduces the budget for machinery procurement consecutively for 10 years
(to the level of approximately 50% from the peak time)

- **Development for improving the efficiency of sidewalk snow removal**
- **Development for improving the safety of sidewalk snow removal**

Introduced into several branches in Japan
Showed the cost reduction effect.

- Future effort -

1. **Creation of a barrier free environment in snowy regions, suitable for aging population**
2. **Diversity of socioeconomic activity**
3. **Cost deduction of snow removal with gaining better understanding from sidewalk user.**
4. **Cooperation with local inhabitants**

The establishment of effective snow-removal systems to keep pace with the changes in society

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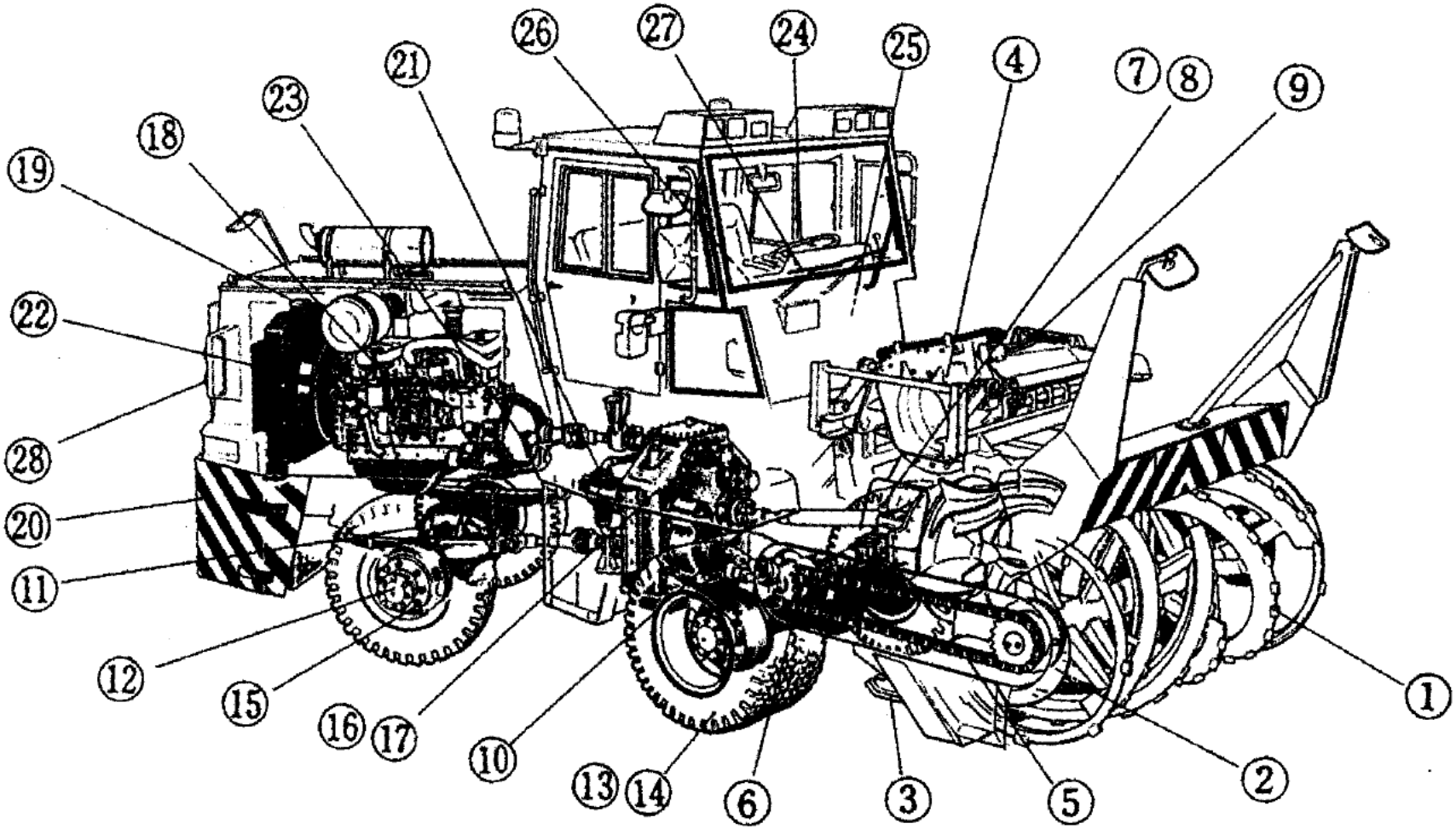

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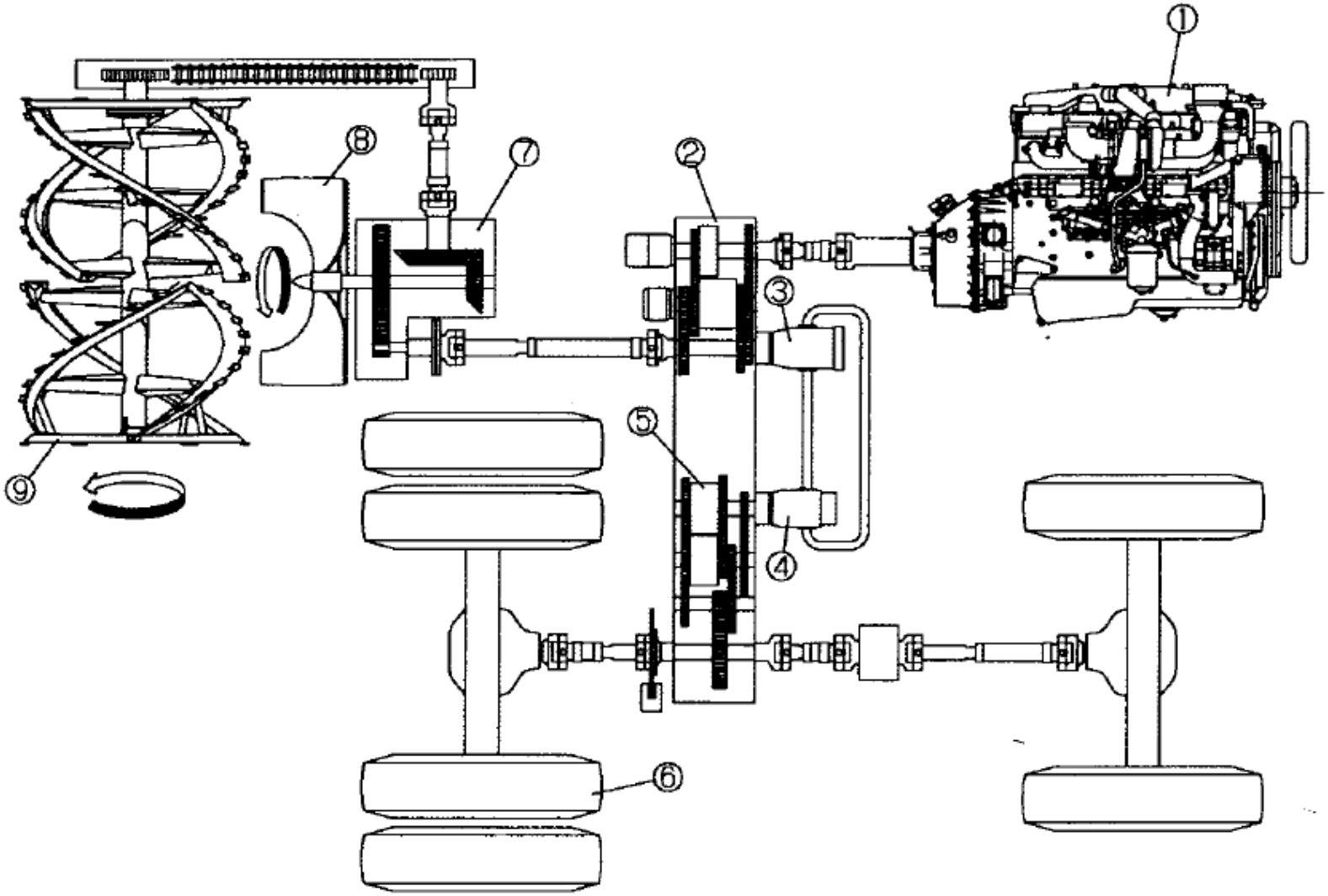
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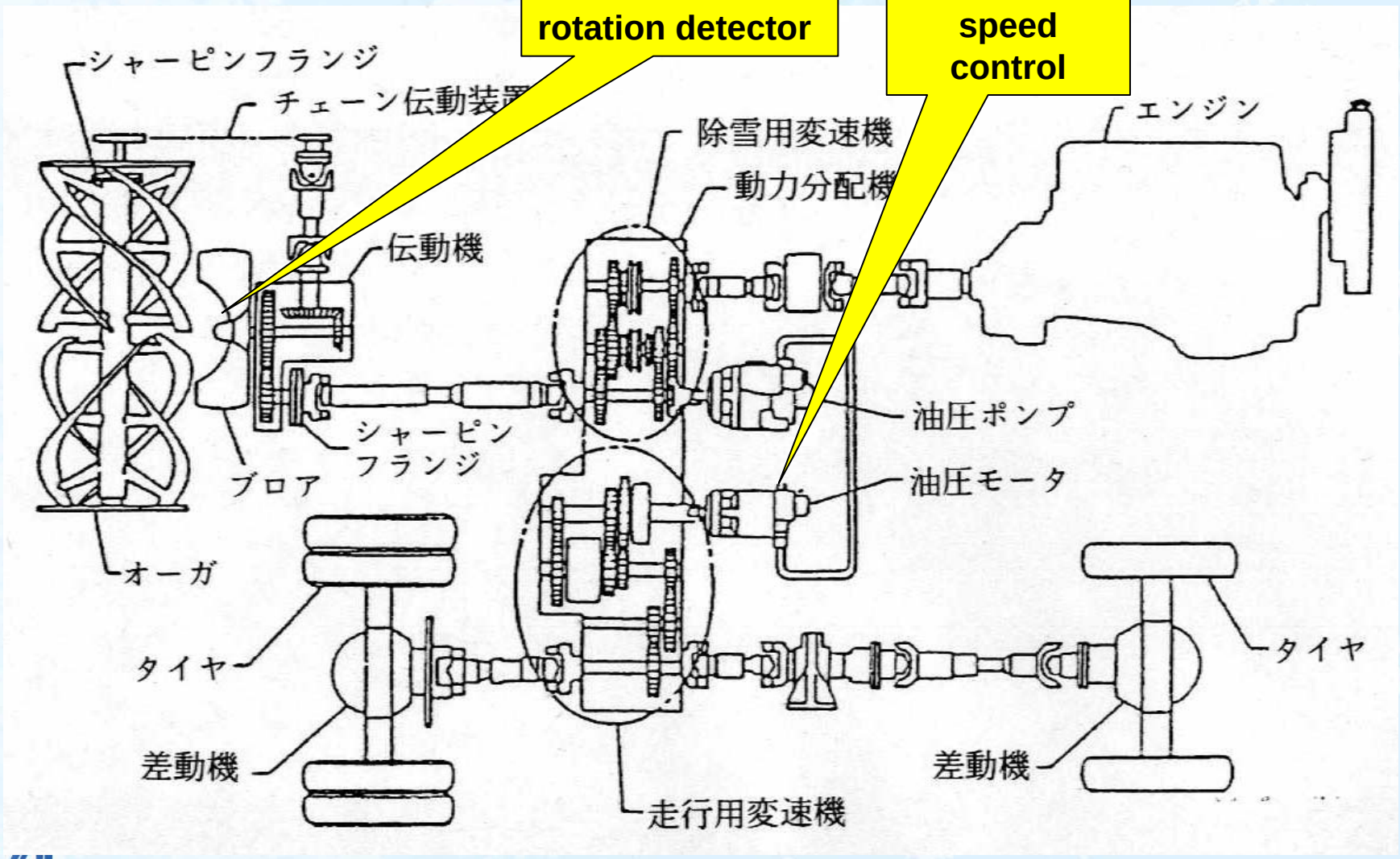
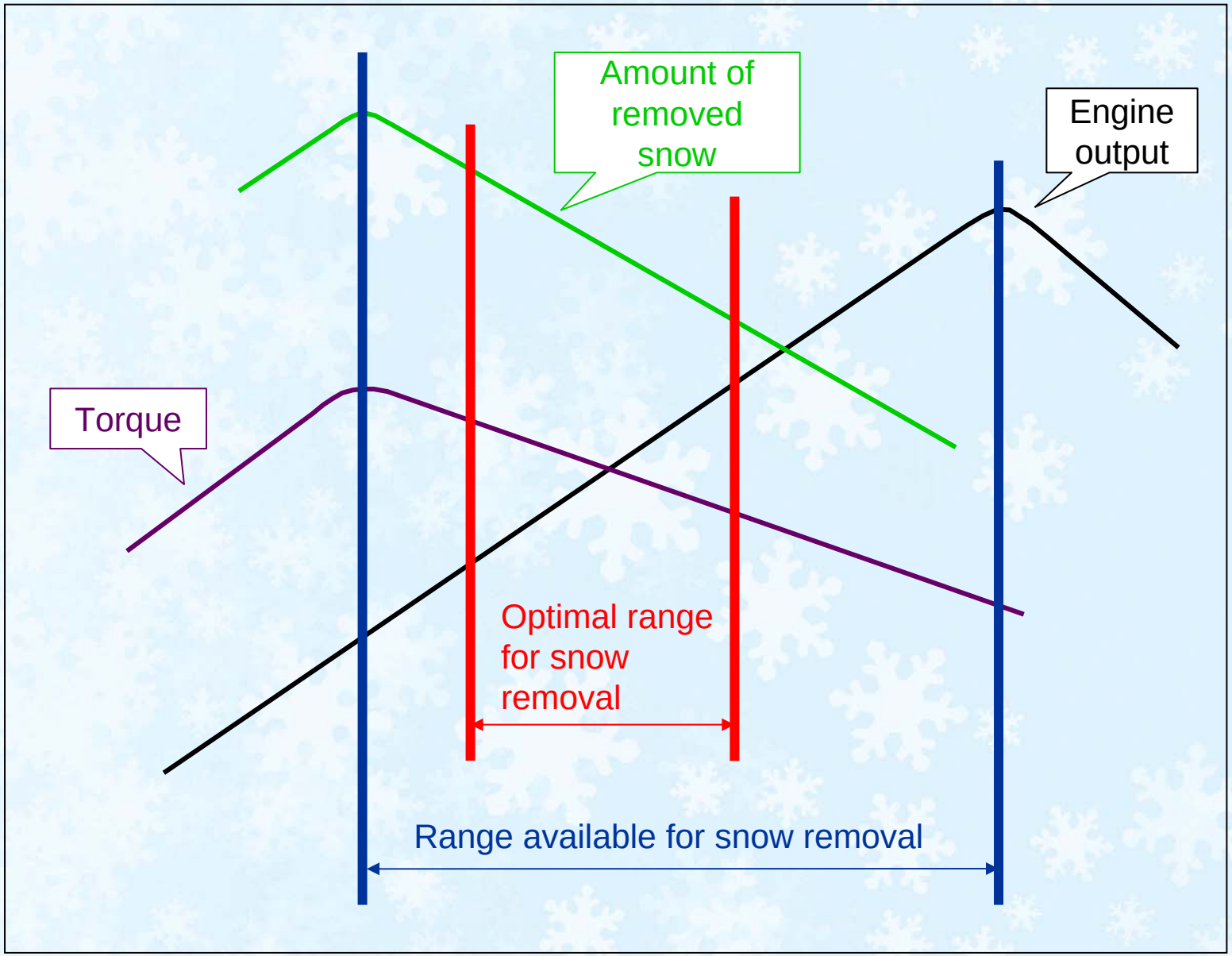
●Power Line for Small Snow-Removal Vehicle





Pattern Diagram of Snow Removal Capacity for Rotary Snow Removal Vehicles