

Carbon Neutral Strategies for Transport Sector in Korea

- focused on key indicators for monitoring

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NDC and Strategies for Carbon Neutral

■ 2030 NDC in Korea

Emissions in 2018	Emissions in 2030 (2030 NDC)	Emissions in 2030 (2030 NDC Rev.)	Emissions in 2050 (2050 Scenario)
98.1 million tons	61 million tons (37.8% decrease compared to '18)	61 million tons (37.8% decrease compared to '18)	2.8~9.2 million tons (90.6~97.1% decrease compared to '18)
BEV/FCEV 56,649 vehicles (included in 9,938 commercial vehicles)	BEV/FCEV 4,500,000 vehicles (included in 500,000 commercial vehicles)	BEV/FCEV 4,500,000 vehicles (adjustment of NO. of BEV and FCEV)	BEV/FCEV 100% conversion (Plan A), 85% conversion (Plan B)

■ Korean Government Strategies(1) - BEV/FCEV conversion

- Incentive : Purchase subsidies, tax benefit, and etc
- Expansion of infrastructure : Supply a fast and convenient charging station environment
- Reforming transport fuel tax

■ Korean Government Strategies(2) - Traffic Demand Management

- Revitalization of public transportation : Introduction of new services, a variety of fares
- Expansion of BRT : BRT/S-BRT expansion linking high-speed railway stations and cities
- Designation of restricted vehicle traffic area : Designation and operation of Low emission zone(LEZ)
- Encouraging non-motorized transport, carbon-free personal transportation : Bicycle, Personal mobility(PM)



NDC and Strategies for Carbon Neutral

- Korea Government announced **23 indicators** for achieving carbon neutral in transport sector.
- Among commercial vehicles, route buses are public transportation means with long total operating mileages and high transport efficiency.
 - However, no implementation indicators are in place to monitor and evaluate their performance effectively.
- Based on the operating characteristics of route buses among commercial vehicles and the level of technology commercialization, it is essential to develop key indicators to evaluate the transition of route buses to ZEBs.

➤ Indicators related to the transition to ZEVs for achieving carbon neutral in Korea

No.	indicators	No.	indicators
1	Number of light-duty electric vehicles	4	Number of electric truck and buses
2	Number of light-duty fuel cell electric vehicles	5	Number of fuel cell truck and buses
3	Number of light-duty hybrid vehicles	6	Number of hybrid truck and buses

Source: Greenhouse Gas Inventory and Research Center of Korea, 2023.



NDC and Strategies for Carbon Neutral

◆ Number of Registered Buses

- As of 2023, there are 44,284 registered route buses in Korea, with an average of 530 companies over the past 10 years.

* City 35,560(80.3%)> Express 5,066(11.4%)> Rural 2,082(4.7%)> Intercity 1,576(3.6%)

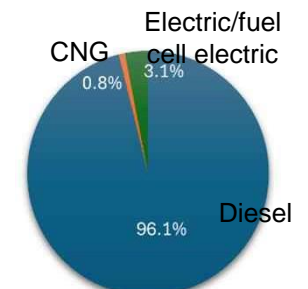
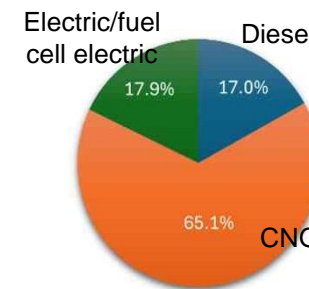
- BEBs/FCEBs account for 6,431 units(approximately 14.5%), of which 99% are city buses and 1% are rural buses.

▶ Number of route buses and electric/hydrogen buses registered

(Unit: vehicles, %)

Category		2017	2018	2019	2020	2021	2022	2023
Total number of registered route buses		45,714	45,520	45,599	45,278	44,659	44,309	44,284
BEBs	Registrations (cumulative)	134	229	695	1,348	2,276	3,944	5,883
	%	0.3	0.5	1.5	3.0	5.1	8.9	13.3
FCEBs	Registrations (cumulative)	0	2	10	65	104	252	548
	%	0.0	0.004	0.02	0.1	0.2	0.6	1.2

- ▶ (Left) Percentage of city buses registered by fuel, (Right) Percentage of rural buses registered by fuel





NDC and Strategies for Carbon Neutral

◆ Policies for BEB/FCEBs

- **Financial support of Purchase subsidy and tax benefit**
 - Approximately 52,000USD(1\$=1,350KRW) for large BEBs, 1.9million USD for FCEBs in 2024
 - Additional subsidy for low-floor buses: 68,100USD (national and city/provincial matching)
 - VAT and Acquisition tax exemption
- **Regulation target to the transportation companies**
 - Six percent of the number of vehicles purchased or leased by passenger transport companies(with 200 or more vehicles at the end of the previous fiscal year) must be electric or fuel cell electric buses
 - As of 2023, 17 transportation companies are subject to the vehicle purchase target system
 - Korea government led initiative that requires private companies to convert 100% of their owned or leased vehicles to zero-emission vehicles(As of 2022, 353 transportation companies(66%) are participating in K-EV100)

Key indicators for monitoring



- **Implementation monitoring is a review of the key strategies established to achieve carbon neutrality in the transportation sector.**
- **Implementation indicators for evaluation should have predetermined targets to assess progress and possess the following characteristics.**
 - Be representative, Use objective data, Developed to allow for sustainable monitoring

➤ Phases of developing key indicators for monitoring

1st: Review the feasibility of achieving government goals



2nd: Pool of implementation indicators through review of government policies & prior research



3rd: Survey of transportation operator & local government



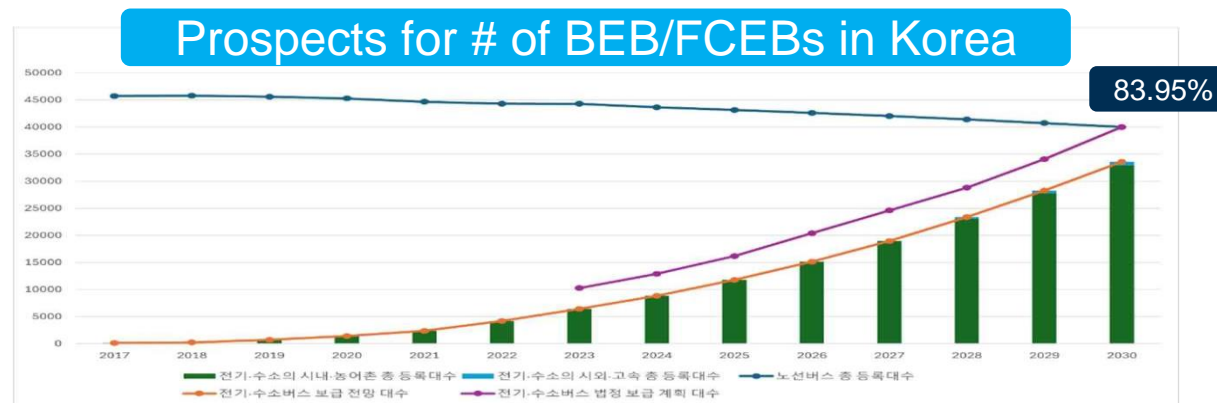
4th: Selection of final Implementation indicator

Key indicators for monitoring

- 1st: Review the feasibility of achieving government goals

- Based on the trend extension method, assumed that the conversion conditions remain the same as they are currently.

category	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total number of registered route buses	45,714	45,787	45,599	45,278	44,659	44,309	44,284	43,650	43,154	42,614	42,028	41,397	40,721	40,000
Prospect of ZEBs(B)	134	231	705	1,413	2,380	4,196	6,431	8,843	11,781	15,145	18,936	23,390	28,271	33,578
Total number of registered ZEBs (city and rural buses)	134	231	705	1,413	2,380	4,196	6,431	8,843	11,781	15,145	18,936	23,153	27,797	32,868
Total number of registered ZEBs (intercity and express buses)	0	0	0	0	0	0	0	0	0	0	0	237	473	710
Statutory distribution plan for ZEBs(C)							~10,263	12,895	(-)	(-)	(-)	28,816	34,079	40,000
B/A(%)	0.29	0.50	1.55	3.12	5.33	9.47	14.52	20.26	27.30	34.54	45.06	56.50	69.42	83.95



Key indicators for monitoring

- 2nd: Set the Pool of implementation indicators(1)

▪ Review of the 1st Basic Plan for Carbon Neutrality and Green Growth

• Detailed task(1-4-1) ① Promote the deployment of ZEVs

- Provide purchase subsidies according to performance(such as mileage per charge) and tax benefits considering the level of environmental-friendly
- Expand the range of vehicle models that must be purchased by the public sector and gradually increase the target distribution ratios in the private sector
- Prioritize conversion to ZEVs according to industry characteristics and dedicated high-capacity charging infrastructure for commercial vehicles

• Detailed task(1-4-1) ③ Prepare fast and convenient charging infrastructure for electric/hydrogen vehicles

- Establish customized charging infrastructure centered on residential and transportation hubs considering vehicle types and driving patterns



Key indicators for monitoring

- 2nd: Set the Pool of implementation indicators(2)



Implementation indicator	Description	Target vehicle type	Remarks
① BEBs and FCEBs distribution target achievement rate	Evaluate the extent of actual distribution compared to the planned supply based on purchase subsidy allocations by vehicle type	City/intercity/express/rural	New
② TCO by vehicle type	Evaluate the extent of price competitiveness secured over the total vehicle ownership period by reducing vehicle purchase and maintenance costs	City/intercity/express/rural	Park et al. (2023)
③ Public sector mandatory purchase achievement rate	Monitor progress (3% of target vehicles) to assess the extent of the public sector's leadership efforts	City/intercity/express/rural	New
④ Private sector purchase target achievement rate	Monitor progress (3% of target vehicles) to assess the extent of efforts made by the private sector	City/intercity/express/rural	New
⑤ K-EV100 achievement rate	Monitor progress (3% of target vehicles) to assess the extent of efforts made by the private sector	City/intercity/express/rural	New
⑥ Number of BEBs and FCEBs distributed	Evaluate the number of BEBs and FCEBs registered among route buses	City/intercity/express/rural	Park et al. (2023)
⑦ Ratio of scrapped vehicles replaced by BEBs and FCEBs	Induce prioritized conversion to BEBs and FCEBs considering the operational characteristics of transportation operators(replace vehicles after 9+2 years of service life)	City/intercity/express/rural	Park et al. (2023)
⑧ Electric chargers in depots	Induce infrastructure construction for prioritized conversion to BEBs and FCEBs considering the operating characteristics of transportation operators(depots)	City/intercity/express/rural	Park et al. (2023)
⑨ Electric chargers installed at major hubs	Induce infrastructure construction for prioritized conversion to BEBs and FCEBs considering the operating characteristics of transportation operators(major hubs)	intercity/express	New
⑩ Hydrogen charging stations in the area	Induce infrastructure construction for prioritized conversion to clean vehicles considering the operating characteristics of transportation operators(large-capacity charging)	City/intercity/express/rural	Park et al. (2023)
⑪ Target management system achievement status	A qualitative indicator for efficiently managing GHG reduction targets at large-scale facilities by having the government and companies mutually agree on emission targets, enforce incentives(or penalties), and verify performance	City/intercity/express/rural	New
⑫ Emissions trading system achievement status	A system that sets and manages reduction targets for companies that emit and consume GHG and energy above a certain threshold, and manages GHG reduction targets	City/intercity/express/rural	New



Key indicators for monitoring

- 3rd: Survey of transportation operator & local government

▪ Review the barriers to the adoption by the transport operator

➤ Status of vehicle and charging infrastructure operations

Category	Status
Electric buses	<ul style="list-style-type: none">• Electric bus share is about 71% (=287/406 units)• Average operating distance: 250km/day, longest operating time: 4 hours 30 minutes
Charging Infrastructure	<ul style="list-style-type: none">• Charging is only available at depots, with 46 charging dispensers (about 94~96 electric buses (32.7%) can be charged simultaneously), Mainly charged late at night (2-4 hours) or during service breaks(30-40 minutes)

➤ Pros and Cons of BEBs

Category	Details
Pros	<ul style="list-style-type: none">• Lower operating costs: 30~40% reduction in operating costs compared to CNG buses(including fuel subsidies)
Cons	<ul style="list-style-type: none">• Supply issues with major domestic manufacturers• Operational difficulties as some domestic manufacturers designate separate locations for repair & maintenance• Difficulties in responding to fires due to lack of firefighting manuals for depots and electric buses

Key indicators for monitoring

- 3rd: Survey of transportation operator & local government



- Review the barriers to the adoption by the local government

- Status of vehicle and charging infrastructure operations

Category	Status
BEBs	<ul style="list-style-type: none"> Out of 1,178 buses, 435 are electric buses, accounting for 36.9% ※ CNG 51.4%, electric 31.3%, diesel 15.0%, others 2.3%
Charging Infrastructure	<ul style="list-style-type: none"> Charging infrastructure: Electric(98), hydrogen(1), with plans to install 79 electric chargers ⇒improving charging efficiency from 4.4 chargers per vehicle ⇒ 22.5 chargers per vehicle

- Factors hindering the deployment of BEBs and FCEBs

Category	Details
Insufficient budget for ZEBs	<ul style="list-style-type: none"> Reducing the city's financial burden by increasing the ratio of national and provincial funds may promote the deployment of BEB/FCEBs. It takes more than a year to receive buses from domestic manufacturers after they have been ordered.
Unstable of operating FCEBs	<ul style="list-style-type: none"> High initial investment costs and fuel consumption due to empty vehicle operation (difficulty in installing chargers due to small depot spaces) No alternative if charging stations fail (no charging → no service → increased complaints) Concerns about maintenance and repair (lack of specialized a/s, difficulty in self-repair)



Key indicators for monitoring

- 4th: Selection of final Implementation indicator

- Final indicator development through expert consultation

Implementation indicator		Monitoring entity	Target buses	Remarks	
Primary	Subsidiary				Measurement formula
BEB&FCEBs fleet deployment	① BEBs/FCEBs distribution target achievement rate	= Number of BEBs/FCEBs deployed	Central Government, local governments	City/intercity/express/rural	Output indicator
	② Number of BEBs/FCEBs distributed	= Number of BEBs/FCEBs deployed / Distribution plan ×100	Central Government, local governments	City/intercity/express/rural	Process indicator
	③ Ratio of scrapped vehicles replaced by BEBs/FCEBs	= Number of BEBs/FCEBs adopted/ Number of scrapped vehicles ×100	Central Government, local governments	City/intercity/express/rural	Process indicator
Public-driven efforts	④ Private sector procurement target achievement rate	= Number of organizations that achieved the purchase target/Number of organizations in the purchase target system ×100	Central Government	City/intercity/express/rural	Process indicator
	⑤ K-EV100 achievement rate	= Number of conversion units submitted to K-EV/Conversion plan submitted to K-EV100 campaign ×100	Central Government	City/intercity/express/rural	Process indicator
Charging infrastructure Establishment	⑥ Electric chargers in depots	= Number of BEBs in the region/Number of electric chargers in local depots ×100	Central Government, local governments	City/intercity/express/rural	Output indicator
	⑦ Electric chargers installed at major hubs	= Number of intercity and express BEBs /Number of electric chargers at major hubs ×100	Central Government, (some) local governments	intercity/express	Output indicator
	⑧ Hydrogen charging stations in the area	= Number of FCEBs in the region / Number of hydrogen charging stations	Central Government, local governments	City/intercity/express/rural	Output indicator

Suggestions



- **To achieve carbon neutrality, it is essential to develop indicators for monitoring the implementation status.**
- **Four monitoring phases are suggested in this presentation.**
 - Compose indicator pools that can implement the government's main policy tasks
 - Establish implementation indicators that will help determine whether targets have been achieved and ensure that they are representative, objective, and based on accessible data.
- **Periodical monitoring of the implementation status should be conducted based on key indicators.**
 - Compose the primary indicators(BEB/FCEB's fleet deployment, public-driven efforts, charging infrastructure establishment) and the subsidiary indicators
 - Periodical monitor using the developed indicators are necessary.