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# Russian residential and transportation sectors scenarios: coming to 2050

AIM Training Workshop

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## Narrative Storylines for Two Scenarios

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### **Scenario A (Optimistic)**

- Energy efficiency and technology progress are intensively introduced.
- Real growth GDP per capita is 6.5% per annum.
- Russia keeps energy status and exports more oil and gas. Secondary and tertiary industries are also growing.
- Consumption in business and households sectors is high credited by low interest rates and high incomes.
- Population and its structure aren't drastically changed as compared with the base year.
- Urbanization is slowly go up.
- Transportation infrastructure is highly developed. Service demand has importantly increased.
- Average floor space of houses and offices has significantly grown up.
- Allocation of time spent for leisure is slowly down.
- Workers are motivated by high wages. Men and women are inclined towards more working.



## Narrative Storylines for Two Scenarios

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### **Scenario B (Inertia)**

- Current trends of main socio-economic indicators are kept till 2050.
- Annual real GDP growth rate is 3.5%.
- Export of oil and gas hasn't essentially grown up.
- Consumption in business and households sectors is up as well as in the case of optimistic scenario but at a lower rate.
- Population is considerably reduced as compared with the base year. Age structure is changed in favor of elderly people. Number of households came less owing to depopulation.
- Urbanization is slowly go down.
- Transportation infrastructure is more developed but at a lower rate as compared with the optimistic scenario.
- Average floor space of houses and offices has drastically increased because of putting into operation new buildings and depopulation.
- Allocation of time spent for leisure is slowly up.



## Key Drivers for Two Scenarios

<b>Indicators</b>	<b>Units</b>	<b>Scenario A</b>	<b>Scenario B</b>
Total floor space of houses	Mln m2	6736	5206
Total floor space of commercial and public buildings	Mln m2	1684	1302
Real GDP growth*	Bln USD	13030	3602
Real GDP growth rate	%	6.5	3.5
Population	Mln	142	108
Number of Households	Mln	47	37

\* - Not taking into account purchasing power parity.



## Main Indicators of the Residential Sector

Indicators	Units	2002	2003	2004	2005
Total floor space of residential buildings	Mln m2	2853	2855	2917	2949
Average floor space	M2/capita	19.8	20.2	20.5	20.8
Constructed	Mln m2	33.6	36.4	41.0	43.6

		2005								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Heating	Mtoe	2.5	0.0	12.1	0.8	0.0	46.7	0.0	0.8	62.8
Hot Water	Mtoe	0.4	0.2	5.7	0.2	0.0	20.3	0.0	0.4	27.1
Cooking	Mtoe	0.0	0.7	9.4	0.0	0.0	0.0	0.0	0.6	10.7
Lighting	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8
Appliances	Mtoe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8

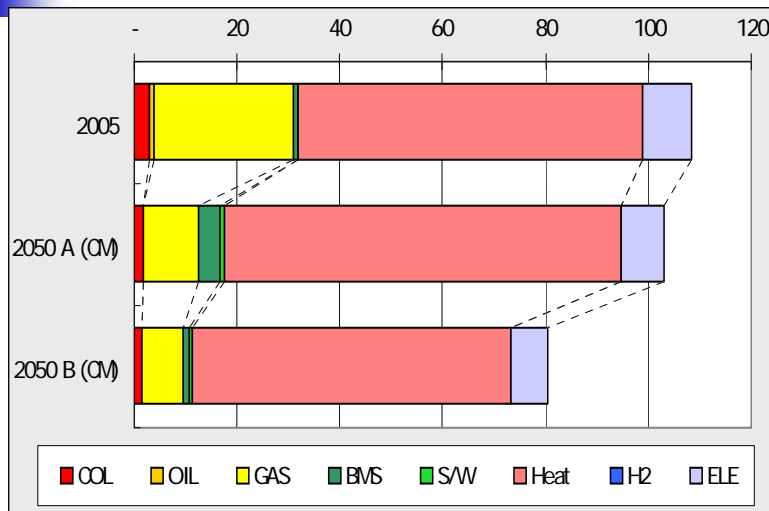
# Future Energy Service Demand in the Residential Sector (Scenario A)

		Service		Change rate of parameters					Change rate of Service	Service		Grounds of Parameter
		Base Year, mtoe	Number of Household $\alpha_1$	Holding rate $\alpha_2$	Operating hours $\alpha_3$	Strength $\alpha_4$	Service Loss $\alpha_5$	Climatic factor $\alpha_6$		BaU(U)	CM/BaU	
									$\Pi(1+\alpha_i)-1$	CM(L)		
Space heating	Scenario A	62.94		127.9%		-10.0%	-10.0%	-5.0%	75%	110.37	0.81	Growth of residential floorspace. Introduction of energy-efficient technologies. Global warming.
	Countermeasure			127.9%		-20.0%	-20.0%	-2.5%	42%	89.50		More intensive introduction of energy-efficiency measurement
Hot water heating	Scenario A	26.94				-10.0%	-10.0%		-19%	21.82	0.79	Population is stable. Introduction of energy efficient technologies.
	Countermeasure					-20.0%	-20.0%		-36%	17.24		More intensive introduction of energy-efficiency measurement
Cooking	Scenario A	10.72			-10.0%				-10%	9.65	0.83	Population is stable. Introduction of energy efficient stoves. Changing of food cooking style production.
	Countermeasure				-25.0%				-25%	8.04		More intensive introduction of energy-efficient stoves.
Electrical appliances	Scenario A	4.84		75.0%	-10.0%				58%	7.62	0.89	Increase of penetration rate for electrical appliances. Use of energy-efficient appliances.
	Countermeasure			75.0%	-20.0%				40%	6.78		More intensive introduction of energy-efficient appliances.
Lighting	Scenario A	2.81			127.9%	-20.0%			82%	5.12	0.75	Growth of residential floorspace. Use of energy-efficient lamps (e.g. compact fluorescent lamp).
	Countermeasure				127.9%	-40.0%			37%	3.84		More intensive introduction of energy-efficient lamps.

# Future Energy Service Demand in the Residential Sector (Scenario B)

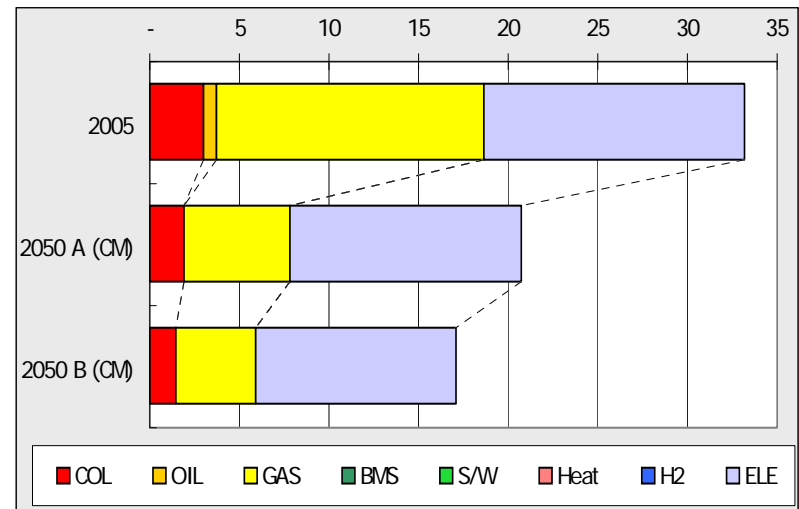
	Service	Base Year, mtoe	Change rate of parameters					Change rate of Service $\Pi(1+a_i)-1$	Service		Grounds of Parameter	
			Number of Household $a_1$	Holding rate $a_2$	Operating hours $a_3$	Strength $a_4$	Service Loss $a_5$		Climatic factor $a_6$	BaU(U)		CM/BaU
										CM(L)		
Space heating	Scenario B	62.94		76.1%		-10.0%	-10.0%	-5.0%	36%	85.30	0.61	Growth of residential floorspace. Introduction of energy-efficient technologies. Global warming.
	Countermeasure			76.1%		-20.0%	-40.0%	-2.5%	-18%	51.88		Autonomous introduction of energy-efficiency technologies and measures
Hot water heating	Scenario B	26.94	-26.4%			-10.0%	-10.0%		-40%	16.05	0.79	Depopulation. Introduction of energy-efficient technologies.
	Countermeasure		-26.4%			-20.0%	-20.0%		-53%	12.68		Autonomous introduction of energy-efficiency technologies and measures
Cooking	Scenario B	10.72	-26.4%		-10.0%				-34%	7.10	0.78	Depopulation. Introduction of energy-efficient stoves. Changing of food cooking style production.
	Countermeasure		-26.4%		-30.0%				-49%	5.52		Autonomous introduction of energy-efficiency technologies and measures
Electrical appliances	Scenario B	4.84		50.0%	-10.0%				35%	6.53	0.89	Increase of penetration rate for electrical appliances. Use of energy-efficient appliances.
	Countermeasure			50.0%	-20.0%				20%	5.81		Autonomous introduction of energy-efficiency technologies and measures
Lighting	Scenario B	2.81			76.1%	-20.0%			41%	3.96	0.75	Growth of residential floorspace. Use of energy-efficient lamps (e.g. compact fluorescent lamp).
	Countermeasure				76.1%	-40.0%			6%	2.97		Autonomous introduction of energy-efficiency technologies and measures

# Application of ESS to Residential Sector



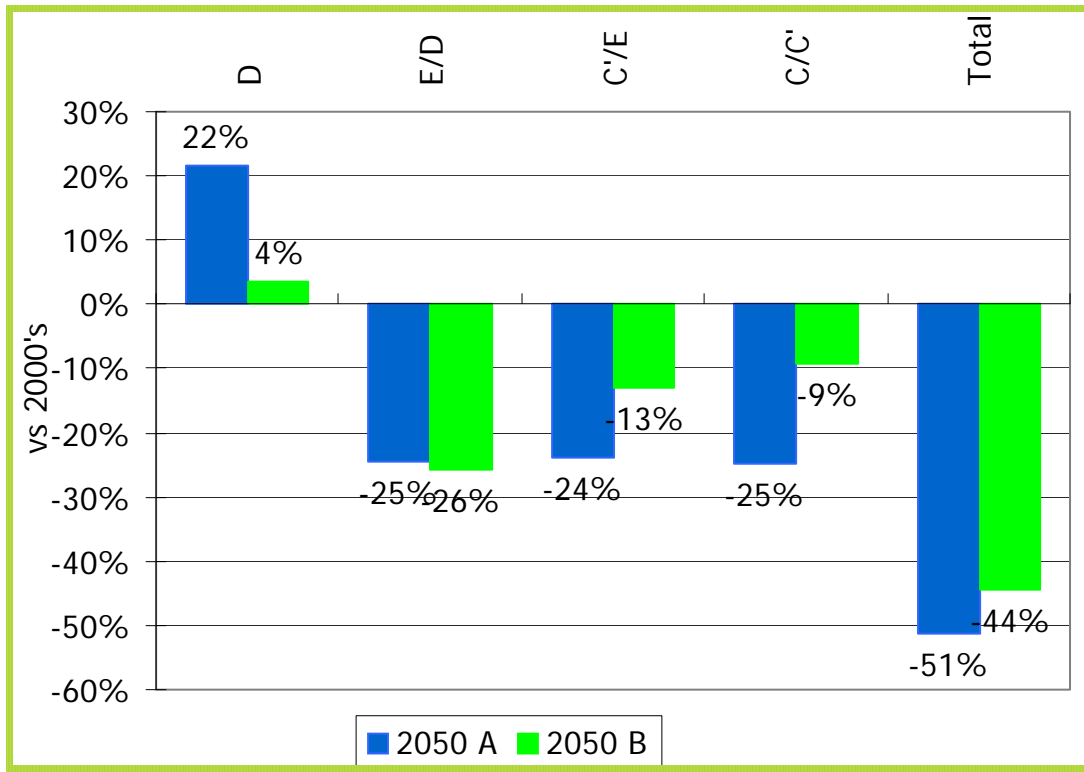
Carbon emissions as a result of countermeasures have decreased by 12 and 16 MtC in Scenario A and B respectively

In spite of the drastic increase in total floor space energy consumption has reduced owing to energy efficiency factors





# Application of ESS to Residential Sector



Aggregate influence of emission factors amounts to 51% for scenario A and 44% for Scenario B



# Demand Settings for Passenger Transportation Sector

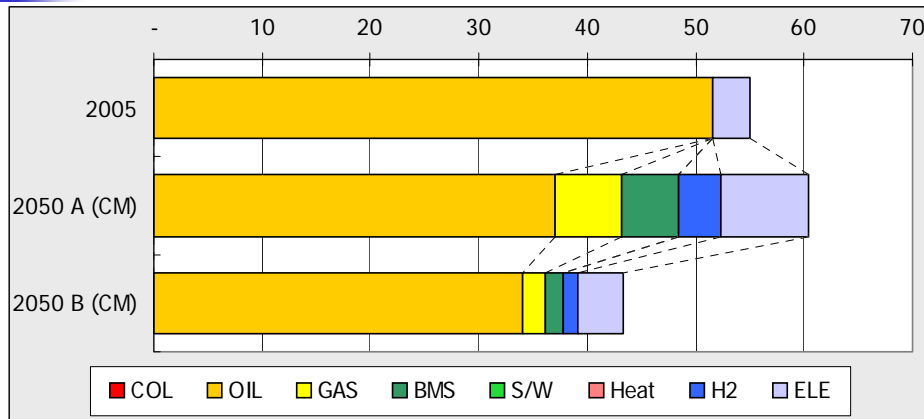
## Scenario A

	Unit	Walk	Bicycle	Motorbike	Car	Bus	Railway	Maritime	Aviation	Grounds for the parameters
Modal Share	%	5%	1%	3%	57.0%	3%	22.0%	1.0%	8.0%	The same grounds as in the "Inertia" scenario case but the trip generation coefficient is higher.
Trip Distance	km/trip	3.00	6.00	9.00	12.00	12.00	15.00	6.00	25.00	
Volume of transportation	mil.passenger-km	17 976	7 191	32 357	819 719	43 143	395 479	7 191	239 684	

## Scenario B

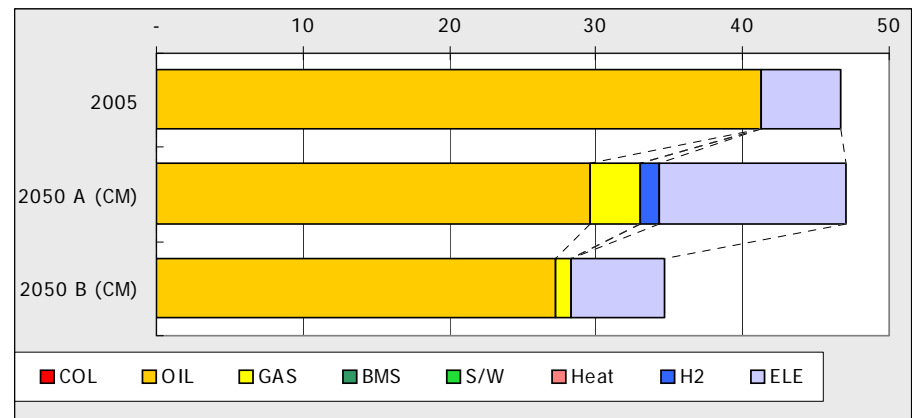
	Unit	Walk	Bicycle	Motorbike	Car	Bus	Railway	Maritime	Aviation	Grounds for the parameters
Modal Share	%	10%	1%	3%	55.0%	3%	20.0%	1.0%	7.0%	Increase of trip generation coefficient. Growing penetration (holding) rate of cars as compared to the base year. Supposed bus stocks decrease. Development of railroads cover and train stocks. Development of ports infrastructure and increase of vessels. Development of airports infrastructure and increase of airplanes.
Trip Distance	km/trip	3.00	6.00	9.00	12.00	12.00	15.00	6.00	25.00	
Volume of transportation	mil.passenger-km	25 295	5 059	22 765	556 479	30 353	252 945	5 059	147 551	

# Application of ESS to Passenger Transportation Sector

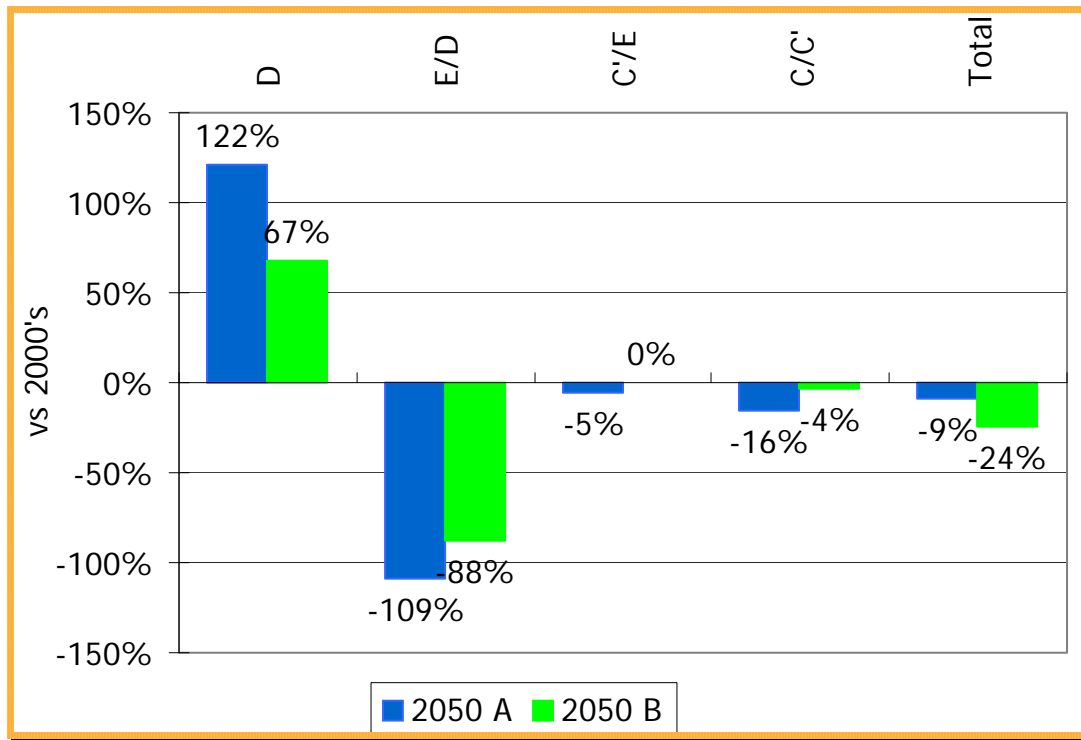


Essential increase of volume passenger traffic in Scenario A despite of energy efficiency leads to energy consumption growth

Countermeasures allow restraining carbon emission in Scenario A and decreasing by 14 MtC in Scenario B



# Application of ESS to Passenger Transportation Sector



Aggregate influence of emission factors amounts to 9% for scenario A and 24% for Scenario B

## Main Indicators of the Freight Transportation Sector

Indicators	Units	2002	2003	2004	2005
Freight train	Bln t-km	1510	1669	1802	1858
Small freight vehicles	Bln t-km	23	25	29	37
Freight ship	Bln t-km	166	136	125	119
Freight air	Bln t-km	2.7	2.7	3.0	2.8

		2000								
		COL	OIL	GAS	BMS	S/W	Heat	H2	ELE	Total
Small Freight Vehicle	Mtoe	0.0	38.1	0.1	0.0	0.0	0.0	0.0	0.0	38.2
Large Freight Vehicle	Mtoe	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	6.7
Freight Train	Mtoe	0.2	2.5	0.0	0.0	0.0	0.0	0.0	0.4	3.1
Freight Ship	Mtoe	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Freight Air	Mtoe	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Pipelines (oil)	Mtoe	0.0	0.0	0.3	0.0	0.0	0.0	0.0	1.2	1.5
Pipelines (natural gas)	Mtoe	0.0	0.0	33.2	0.0	0.0	0.0	0.0	0.5	33.7



# Demand Settings for Freight Transportation Sector

## Scenario A

Category	Service Demand in base year		Service Demand in target year		Grounds for the parameters
		Unit		Unit	
Small freight vehicles	37	b ton-km	42	b ton-km	GDP growth.
Large freight vehicles	194	b ton-km	300	b ton-km	The same grounds as in "Inertia" scenario but more intensive.
Freight train	1858	b ton-km	2 093	b ton-km	The same grounds as in "Inertia" scenario but more intensive.
Freight ship	119	b ton-km	138	b ton-km	The same grounds as in "Inertia" scenario but more intensive.
Freight air	2.8	b ton-km	4	b ton-km	The same grounds as in "Inertia" scenario but more intensive.
Pipelines (oil and petroleum products)	1116	b ton-km	1 294	b ton-km	The same grounds as in "Inertia" scenario but more intensive.
Pipelines (gas)	1623	b m3-km	1 972	b m3-km	The same grounds as in "Inertia" scenario but more intensive.

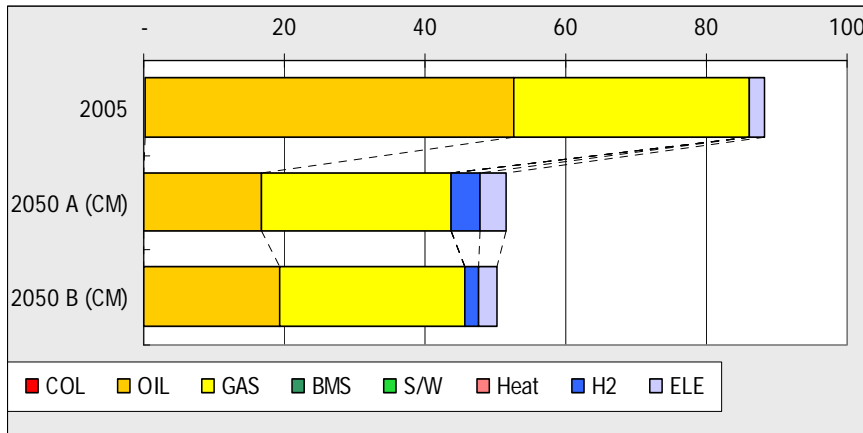
# Demand Settings for Freight Transportation Sector

## Scenario B

Category	Service Demand in base year		Service Demand in target year		Grounds for the parameters
		Unit		Unit	
Small freight vehicles	37	b ton-km	31	b ton-km	Depopulation restrains development of this sector.
Large freight vehicles	194	b ton-km	257	b ton-km	The world-wide GDP growth. More intensive growth of service demand by this sector compensates insufficient development of the other freight sectors.
Freight train	1858	b ton-km	1 950	b ton-km	The world-wide GDP growth. Insufficient rate of railroads cover development and train stocks renovation restrains the development of this sector.
Freight ship	119	b ton-km	125	b ton-km	The world-wide GDP growth. Insufficient rate of ports infrastructure development and vessels rate of renovation restrains development of this sector.
Freight air	2.8	b ton-km	3	b ton-km	The world-wide GDP growth. Insufficient rate of airports infrastructure development and vessels rate of renovation restrains development of this sector.
Pipelines (oil and petroleum products)	1116	b ton-km	1 239	b ton-km	The world-wide GDP growth. Insufficient rate of new deposits development and lines renovation, low rate of energy efficiency improvement as well as higher demand from the domestic customers don't allow growing up oil and petroleum products transportation.
Pipelines (gas)	1623	b m3-km	1 796	b m3-km	The world-wide GDP growth. Insufficient rate of new deposits development and lines renovation, low rate of energy efficiency improvement as well as higher demand from the domestic customers don't allow growing up oil and petroleum products transportation.

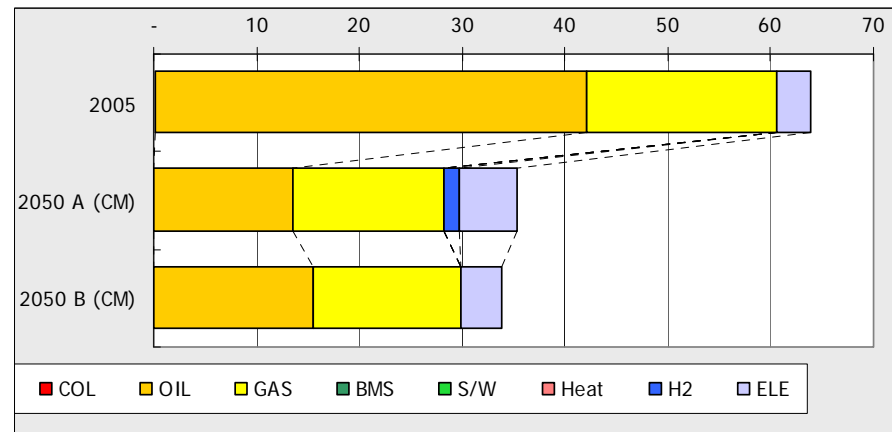


# Application of ESS to Freight Transportation Sector

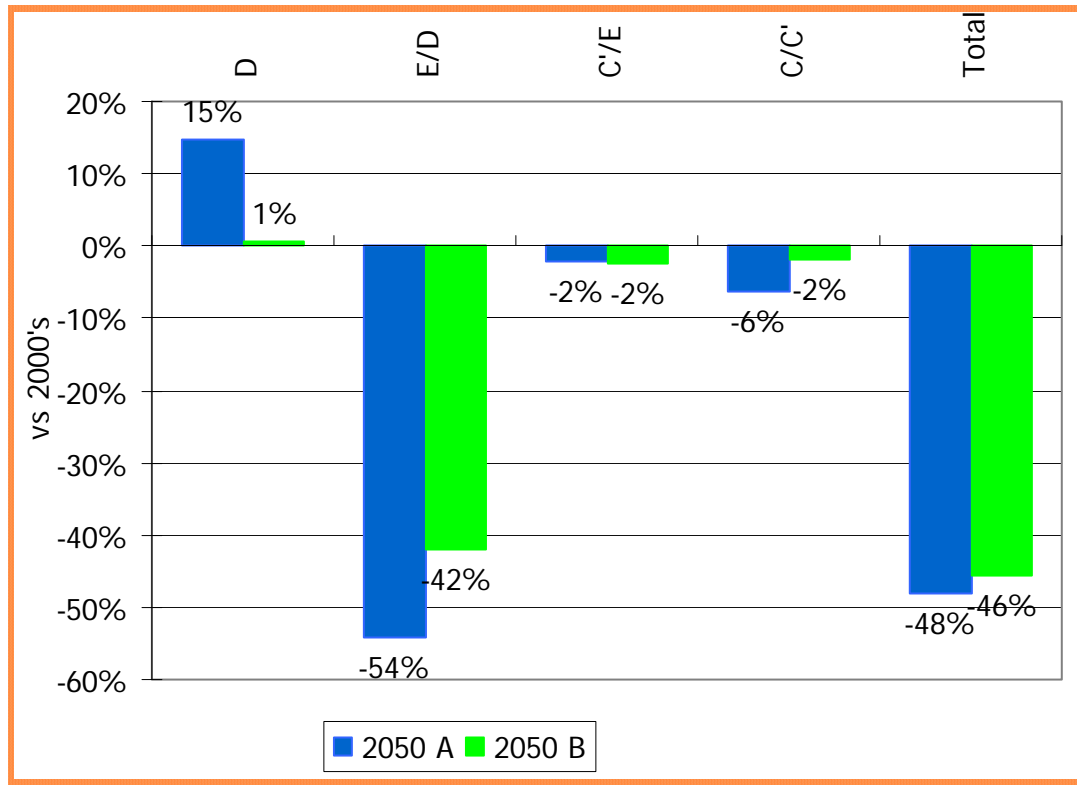


More energy efficient technologies introduction in Scenario A despite of more intensive growth of freight traffic volume allowed approximately the same energy consumption demand as compared with Scenario B

Countermeasures decreases carbon emission by 29 MtC and 30 MtC in Scenario A and B respectively



# Application of ESS to Freight Transportation Sector



Aggregate influence of emission factors amounts to 48% for scenario A and 46% for Scenario B