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CO_2 Emissions from Urban Transport and Residential Sectors in Thailand

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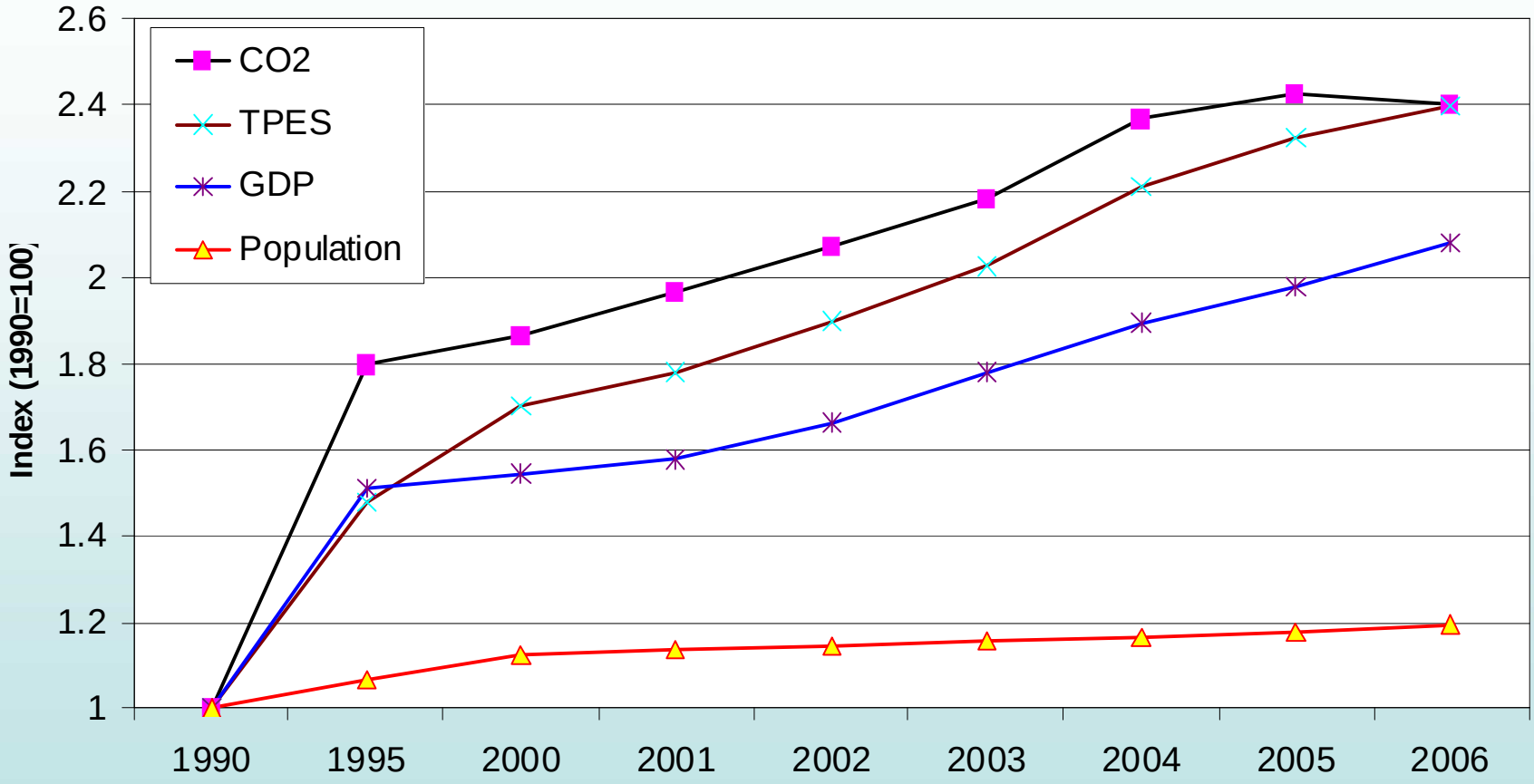
CO_2, TPES, GDP and Population Growth during 1990-2006



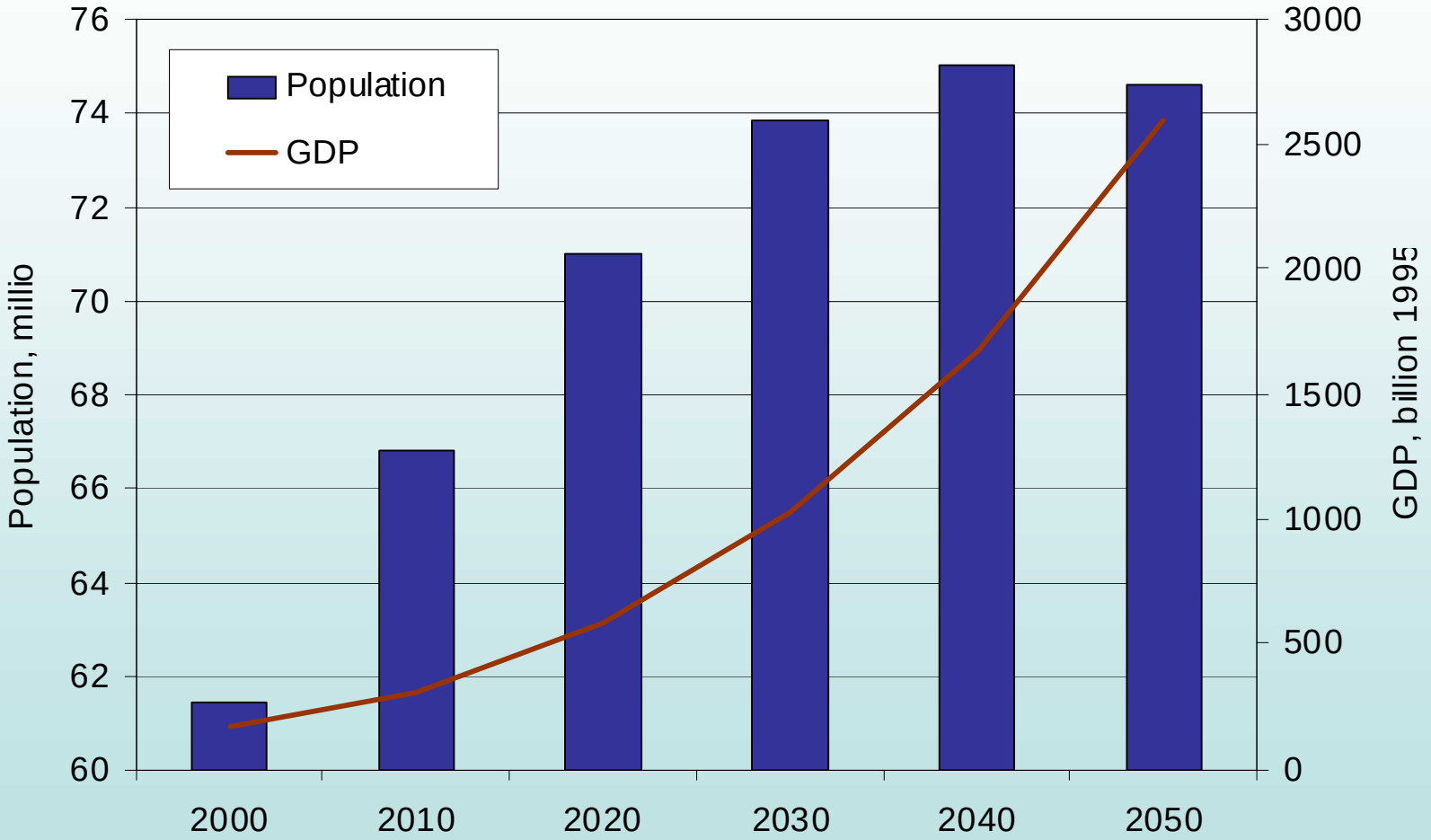
AAGR (2001-2006):

CO_2: 4.35% Population: 1.02%

TPES: 5.91% GDP: 5.07%

Source: DEDE, 2006, IMF, 2008, IEA, 2007 and 2008

GDP and Population in the Base Case (2000-2050)



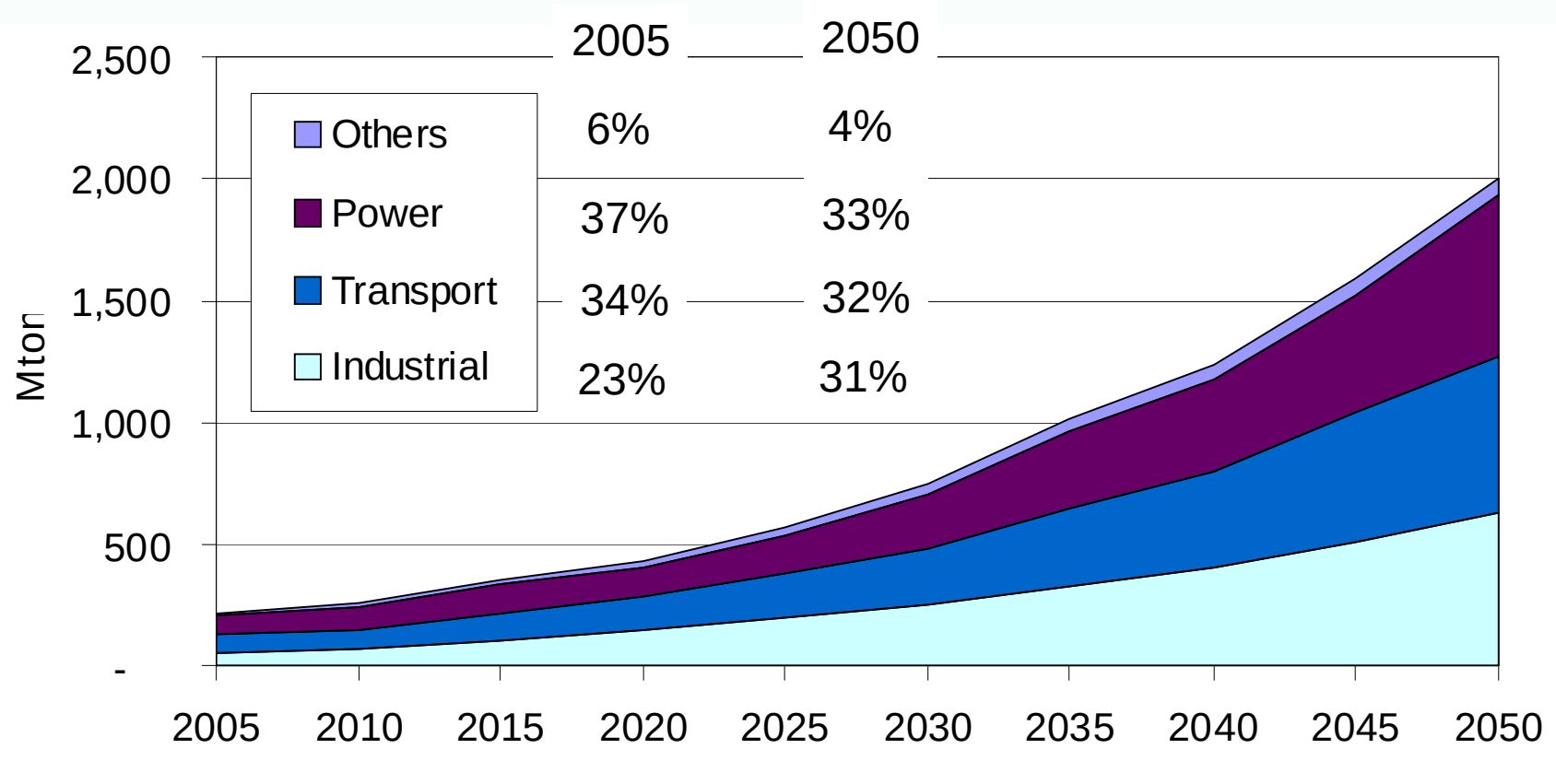
CAGR (2000-2050):

Population: 0.4% GDP: 5.6%

Sources: TDRI, 2004; UN, 2006

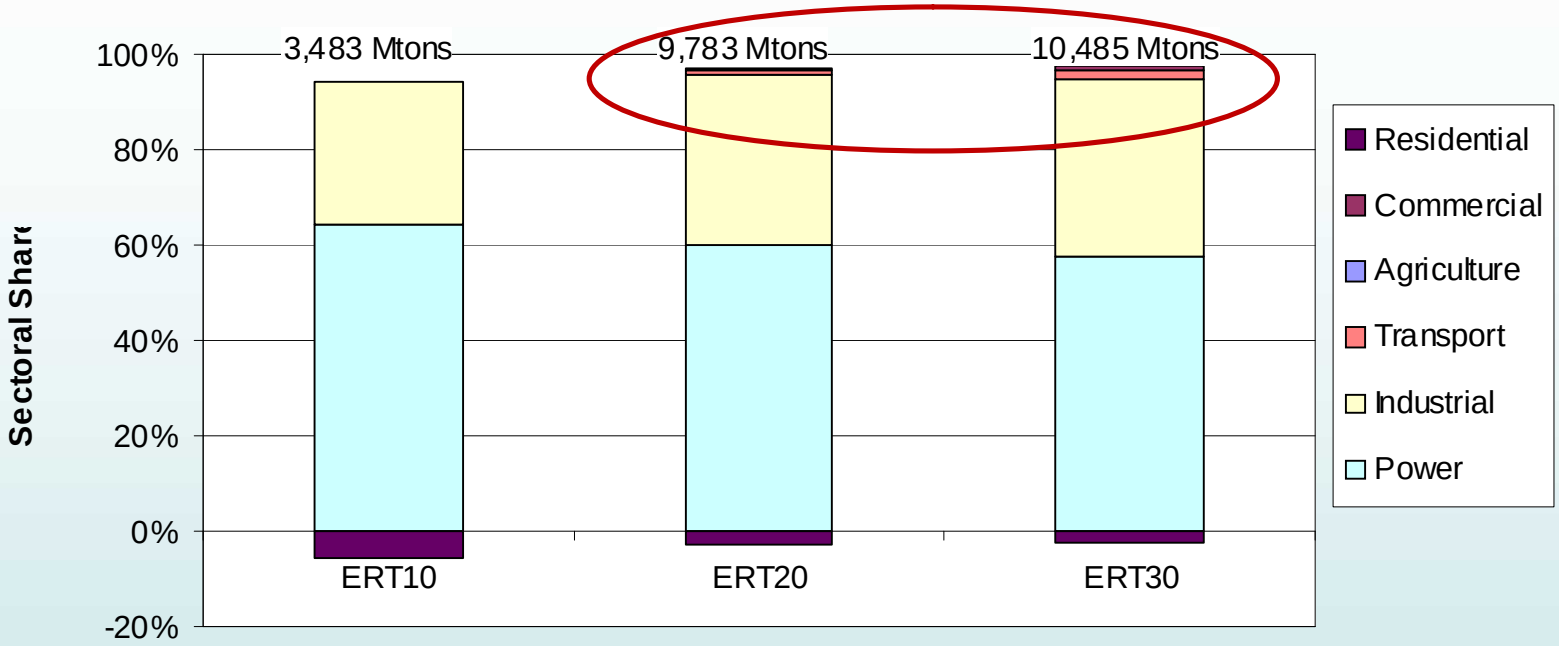
Urban population: about 35% (2005); projected to be about 65% by 2050

How much CO_2 would be emitted from all sectors in the base case?



Total CO_2 emission would increase by more than 9 fold during 2005-2050 (AAGR 4%), i.e., 223 million tCO_2 in 2005 to 2,006 million tCO_2 in 2050.

Sectoral contributions to CO_2 emission reduction



- Very low contribution of the transport sector.
- Highest CO_2 emission reduction in the power sector, followed by the industrial sector.
- Over 73%, 64% and 61% of the total CO_2 emission reduction from the power sector in ERT10, ERT20 and ERT30 cases respectively.
- Mainly use of natural gas based advanced combined cycle power generation and carbon capture and storage (CCS) and nuclear based power generation play major role in CO_2 emission reduction.
- Maximum of 36% emission reduction target possible from the base case.

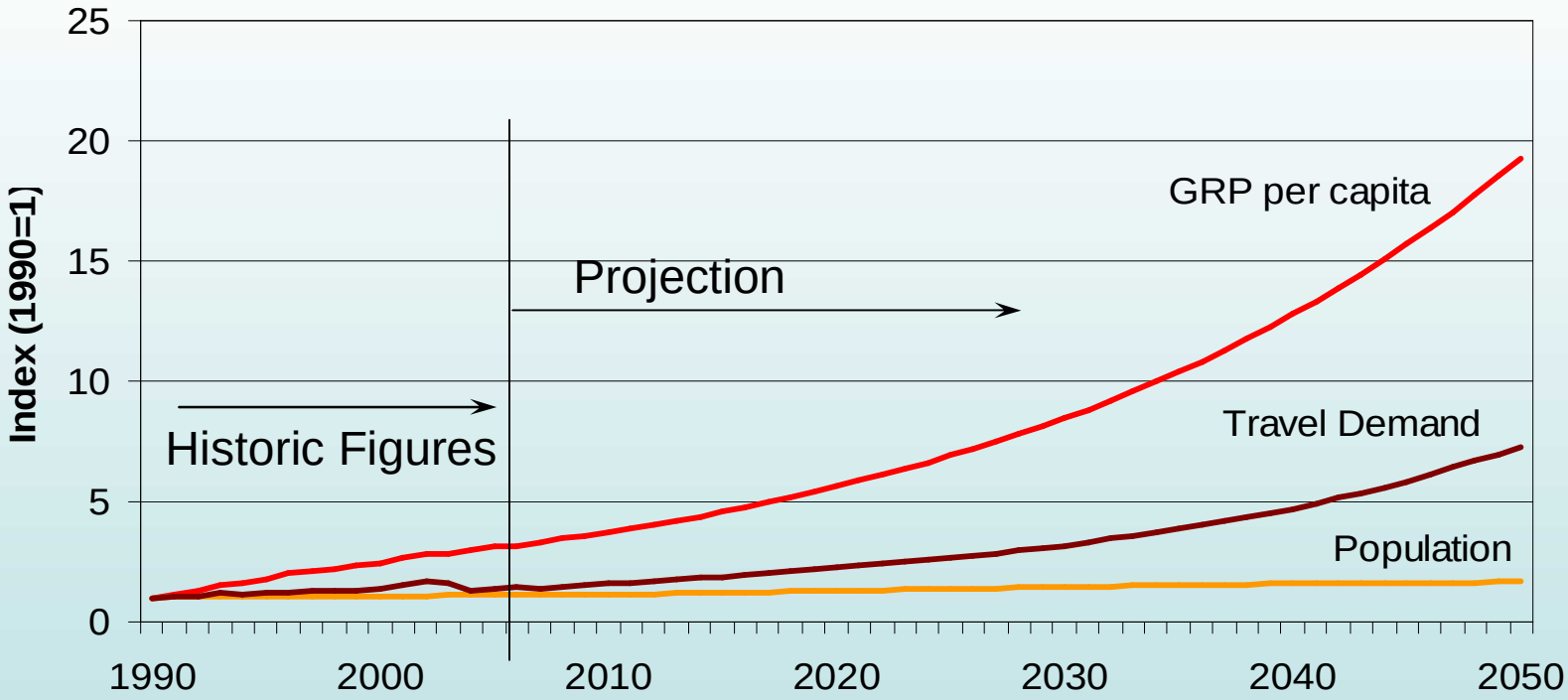
CO_2 Emission Reduction from Bangkok Passenger Transport

Background

- Bangkok: one of the 11 megacities located in Asia.
- Bangkok Metropolitan Area (BMA) - 1568 square km
- Population: 6.8 million in 2006 (10% of total population in Thailand)
- Population density of BMA: 4,372 persons per square km in 2006 (3,869 in 1990) (NSO, 2007).

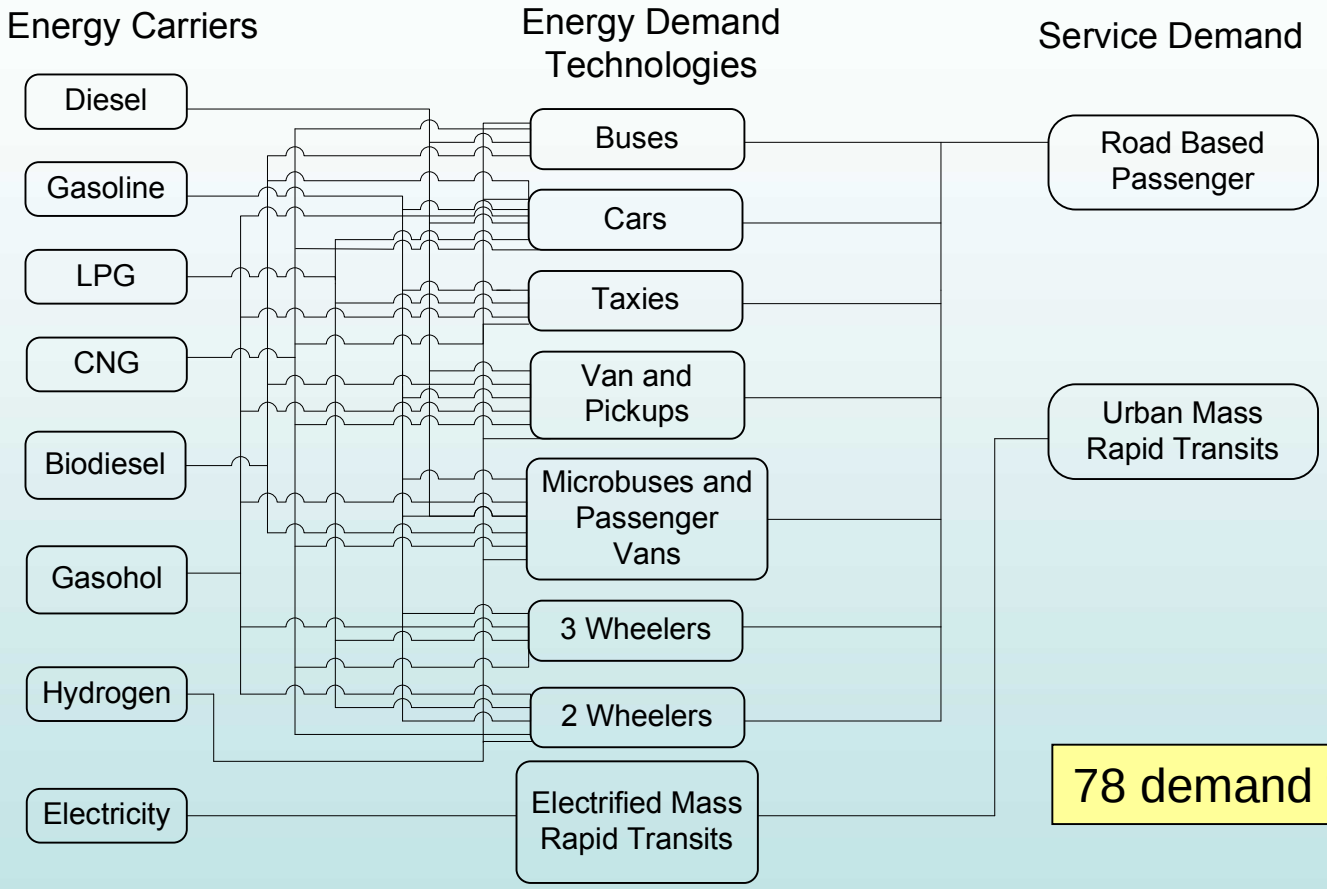
- Growing gross regional product (GRP): 6.1% AAGR during 1990-2006, (slightly less than that of Thailand's AAGR (8.4%)).

Index of GRP per capita, Travel Demand and Population in BMA (1990-2050)



Period	Index	GRP per capita	Population	Travel Demand
1990-2005	1990=1	3.16	1.12	1.34
2005-2050	2005=1	6.11	1.50	5.30

Passenger Transport System under MARKAL Model Framework



78 demand technologies

MARKAL – least cost optimization model

Scenario Description

Base Case:

- No policy intervention considering GHG mitigation is considered in the base case.

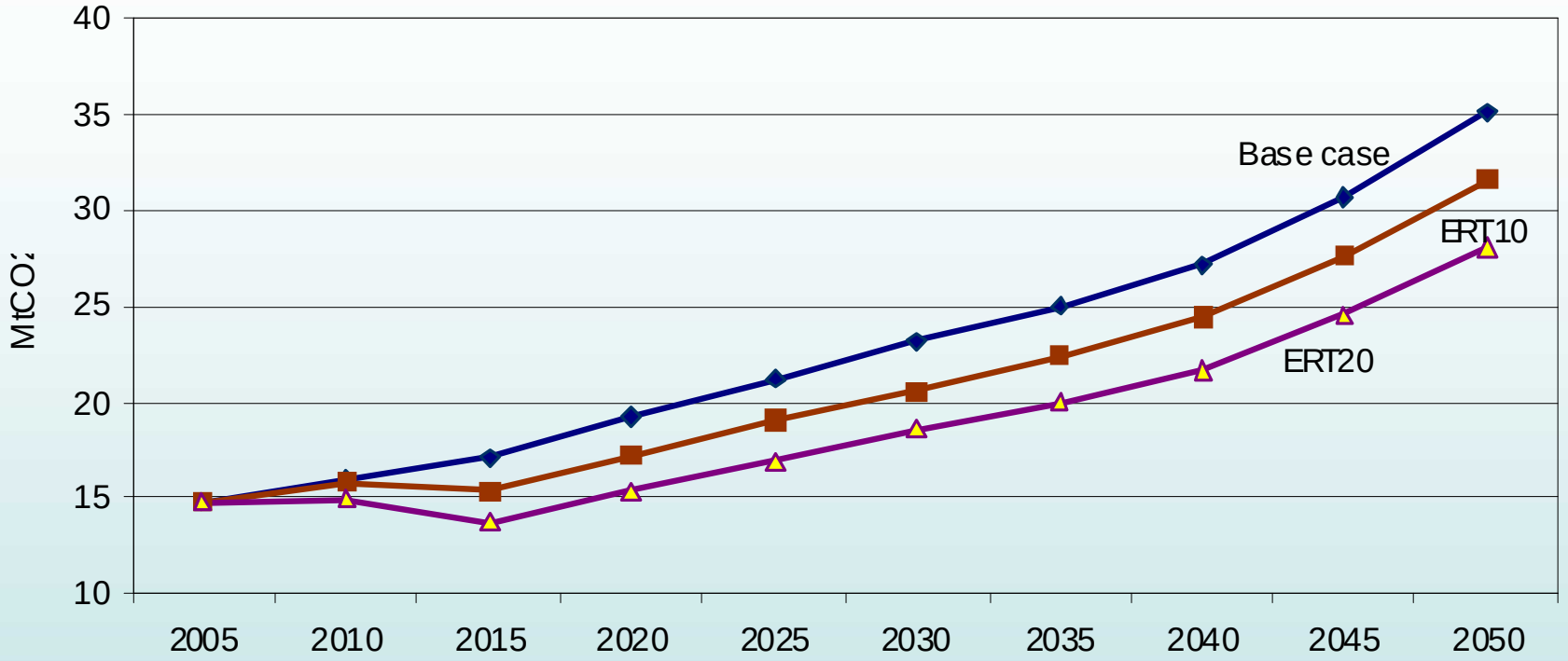
ERT10:

- 10% or more CO_2 emission reduction from the base case from year 2015 onward remaining all others as same as in the base case.

ERT20:

- Requirement of 20% or more CO_2 emission reduction from base case from year 2015 onward remaining all others as same as in the base case.

CO_2 Emission in ERT Cases



- The total cumulative CO_2 emission reductions—ERT10: 94 $MtCO_2$ (about 3% of total national level reduction in ERT10) and
- ERT20: 188 $MtCO_2$ (about 2% total national reduction in ERT20)

Role of Cleaner Fuels in Emission Reduction

Fuel Type	Energy Consumption, PJ			Changes in Energy Consumption*, PJ	
	Base Case	ERT10	ERT20	ERT10	ERT20
B10	2,311	1,612	166	(699)	(2,145)
CNG	3,906	5,039	3,906	1,133	-
DSL	5,243	3,805	5,302	(1,438)	58
E10	89	389	418	300	328
ELC	71	71	71	-	-
FCL	-	-	447	-	447
GSL	2,156	1,922	1,851	(234)	(306)
LPG	1,652	1,557	903	(95)	(749)
Total	15,428	14,396	13,063	(1,032)	(2,366)

- Major role of CNG and gasohol vehicles in ERT10.
- Role of cleaner and energy efficient vehicles prominent in ERT20.
- In both ERT10 and ERT20, the use of biodiesel would be reduced through replacement of biodiesel microbuses and vans/pickups with hybrid diesel microbuses, vans/pickups and buses.

Role of Vehicle Modes in CO_2 Emission Reduction

Vehicle Type	Base case Emission, $MtCO_2$	Emission Reduction from the base case, $MtCO_2$		Share in the emission reduction, %	
		ERT10	ERT20	ERT10	ERT20
Bus	161	47	75	50%	40%
Car	123	0	32	0%	17%
Taxi	105	2	15	2%	8%
Micro bus and passenger van	313	28	39	30%	21%
Van and Pickup	290	15	25	16%	13%
3 Wheeler	1	0	0	0%	0%
2 Wheeler	28	2	2	2%	1%
Total	1021	94	188	100%	100%

Role of Emerging Technologies in CO_2 Emission

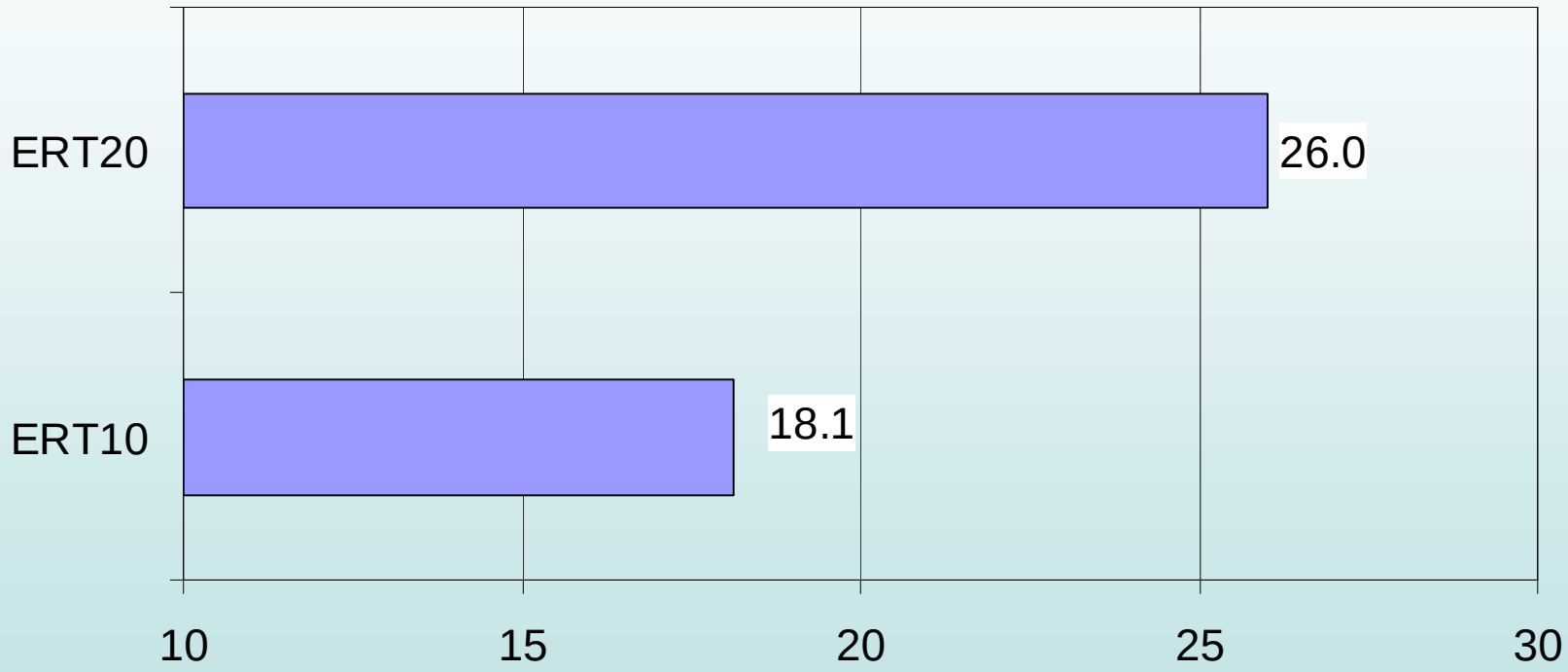
ERT10

- Conventional vehicles mostly replaced by cleaner fuel and energy efficient vehicles.
- Diesel buses replaced by hybrid diesel buses.
- Diesel microbuses/vans replaced by hybrid diesel, biodiesel and CNG microbuses/vans.
- LPG taxies replaced by hybrid gasoline taxies; and gasoline 2-wheelers by gasohol 2-wheelers.

ERT20

- Large scale deployment of hybrid diesel buses needed: nearly twice the number deployed in ERT10. Similarly, microbuses/passenger vans.
- Hybrid diesel vans/pickups would replace biodiesel vans/pickups.
- Fuel cell cars would be deployed from 2035 onwards.
- Use of hybrid gasoline taxi in place of conventional LPG taxi nearly 3 times more than that in ERT10.

Incremental CO_2 Abatement Cost ($/t$CO_2$)



Role of Mass Rapid Transport Systems in Emission Reduction

ERM:

•Maximum CO_2 reduction from the base case emission from the Bangkok transport sector would be 20% with the present structure of urban transport system.

•A shift of 10% travel demand from road based vehicles to MRTs/Railways during 2015-2050 results in a further 8% reduction in total transport sector CO2 emission from that in ERT.
•More reduction at higher shift of travel demand.

CO_2 Reduction from Urban Residential Sector in Thailand

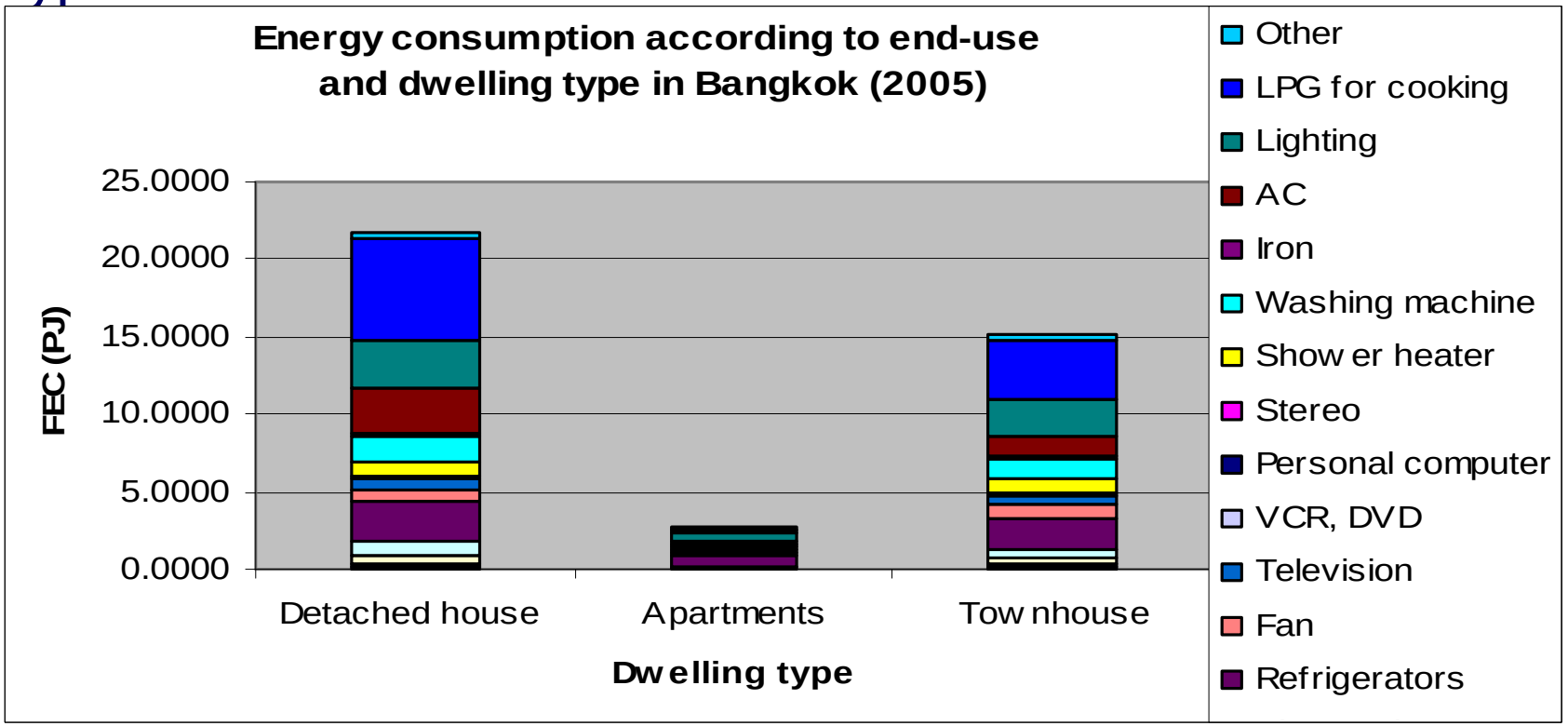
Sithisakdi Apichatthanapath and Ram M. Shrestha

ENERGY CONSUMPTION By DWELLING TYPE IN BANGKOK

		Dwelling type		
Parameters	**Unit**	**Detached**	**Apartment**	**Townhouse**
Average size of household	person	4.1	1.6	3.9
Number of households	1,000 unit	753	492	847
Share to total household	%	36	24	41
Total floor area	million sq.m.	149	15	115
Share of floor area	%	53	6	41
Total energy consumption	PJ	22	3	15
Share of total consumption	%	**55**	**7**	**38**
Energy intensity 1	GJ/dwelling/year	**29**	**5**	**18**
Energy intensity 2	MJ/sq.m./year	**145**	**172**	**132**

		Dwelling type			
Parameters	**Unit**	**Detached**	**Apartment**	**Townhouse**	**Average household**
Average electricity consumption	**kWh/month**	**467**	**115**	**311**	**321**
Average electricity bill	**THB/month**	**1,402**	**346**	**934**	**964**

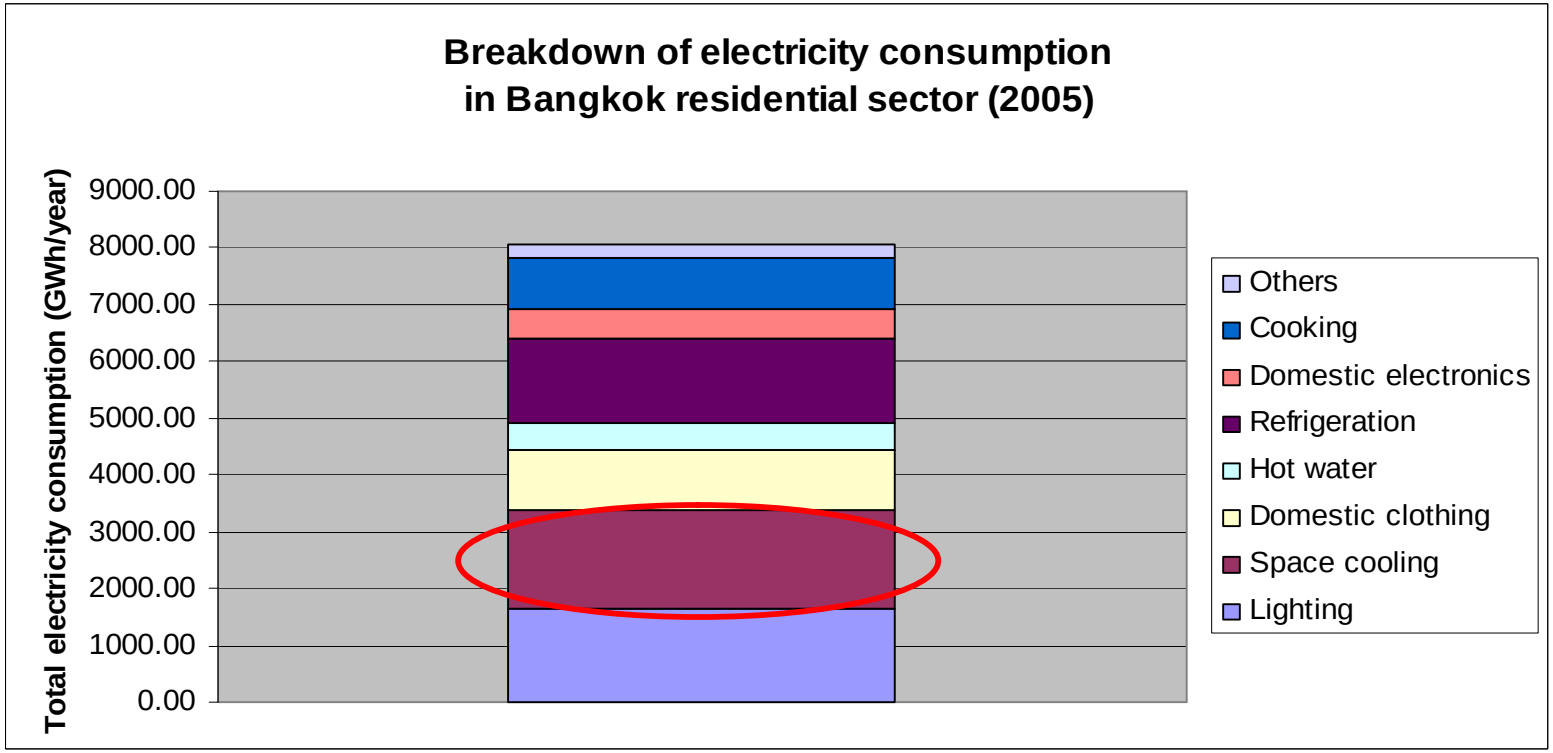
Residential energy consumption by end use and dwelling type



Detached houses account for the largest share in energy consumption in Bangkok residential sector.

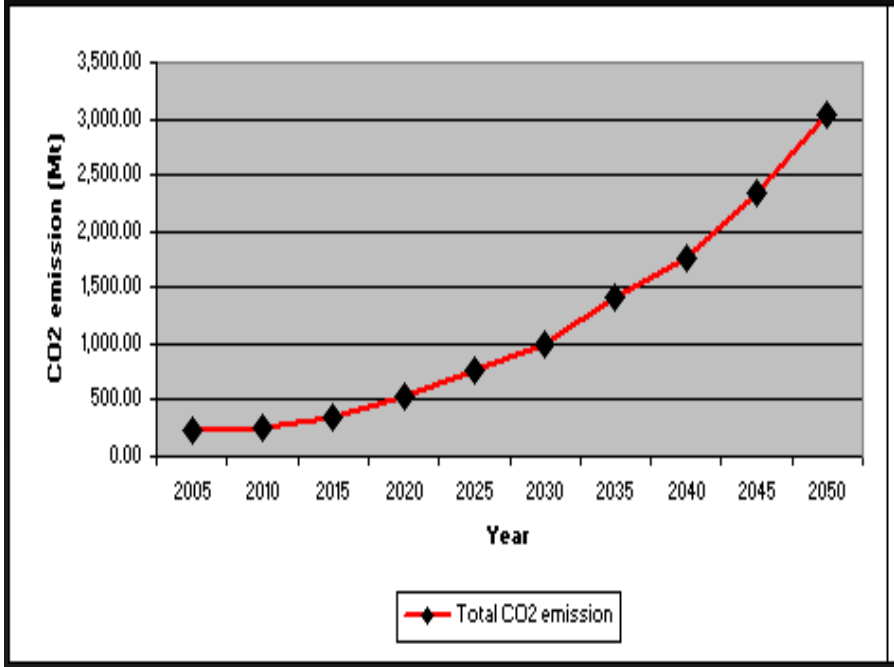
LPG cooking share significant in detached and town house; insignificant in apartments.

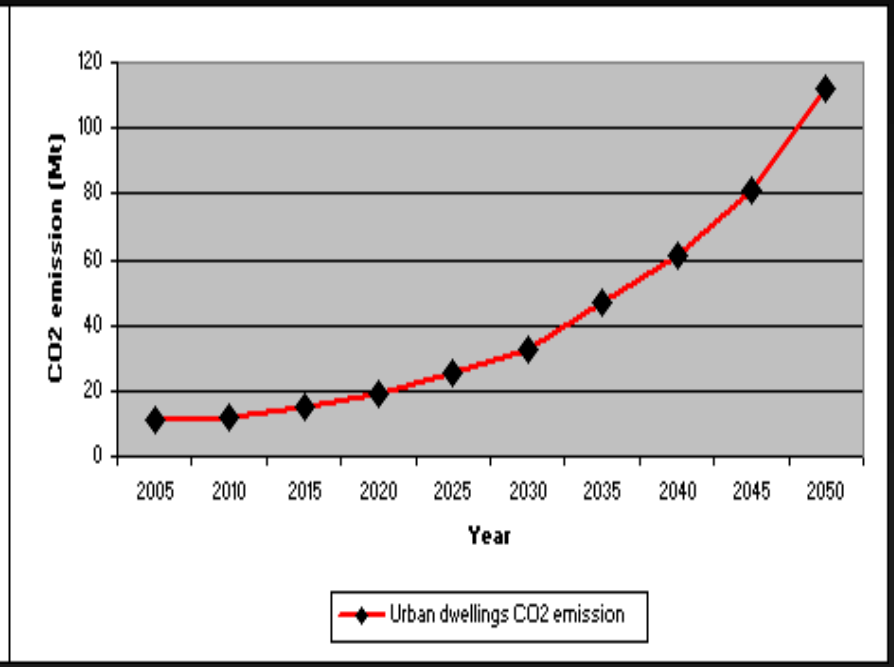
Electricity the main energy carrier.



Space cooling, lighting, refrigeration, cooking – the 4 largest electricity users – over 64% of electricity consumption.

Yearly CO2 emission – national and urban housing





- Total **consumption** in urban housing sector (whole period) accounts for only **2.8% of total FEC.**

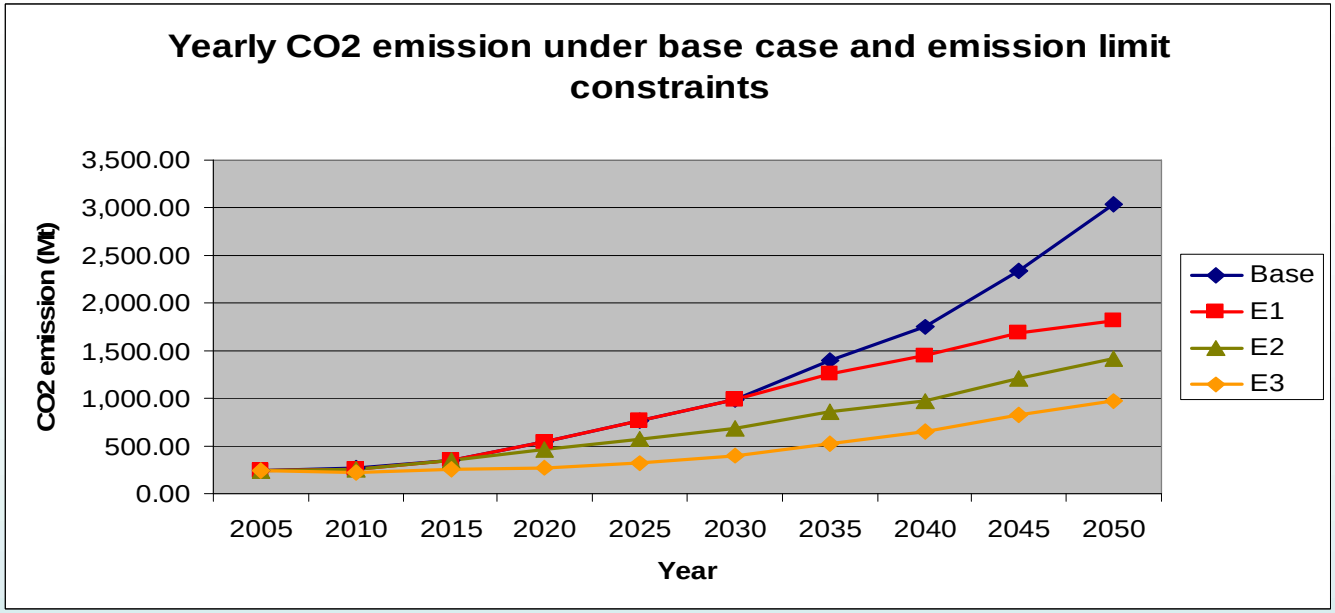
- Thus **small contribution** in terms of CO2 emission; 4.46% in 2005 → 3.7% in 2050.

- Expected AAGR of 6% in urban housing sector; emission to increase by 10-folds to 112 Mt in 2050.

Scenario Description

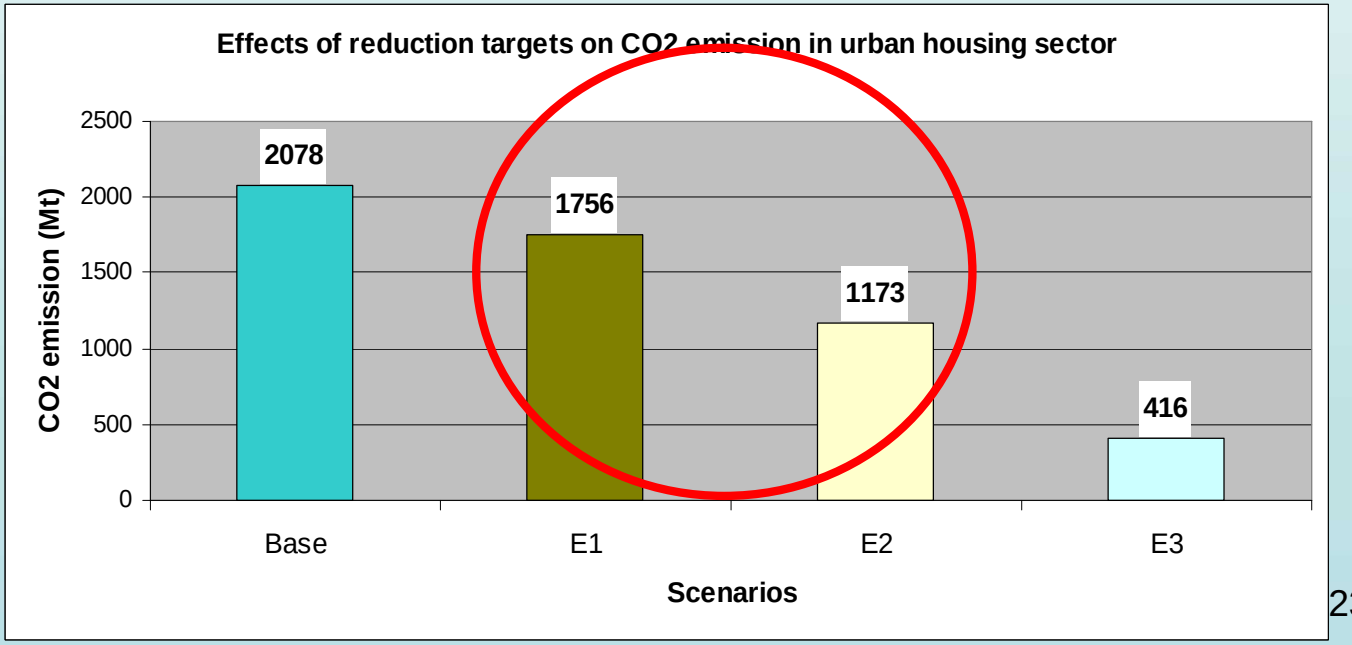
- Base case
- E1: cumulative CO2 reduction by 20% during 2005-2050
- E2: cumulative CO2 reduction by 40% during 2005-2050
- E3: cumulative CO2 reduction by 60% during 2005-2050

CO2 emission in the selected scenarios



CO2 emission reduction from the urban residential sector:

-15%, -33% and -65% of base case national emission from the sector under E1, E2 and E3 respectively.



Contribution of urban residential sector in national CO2 reduction

- Urban residential sector CO2 emission at the national level would decrease by 15%, 33% and 64% in E1, E2 and E3 during 2005-2050.
- Contributions of the urban residential sector in total national CO2 reduction: 2.8% in E1, 3.9% in E2 and 4.7% in E3.

Thank You