A Study of CO_2 Emission Reduction Due to Transportation Activities in Brebes District through Road Repair

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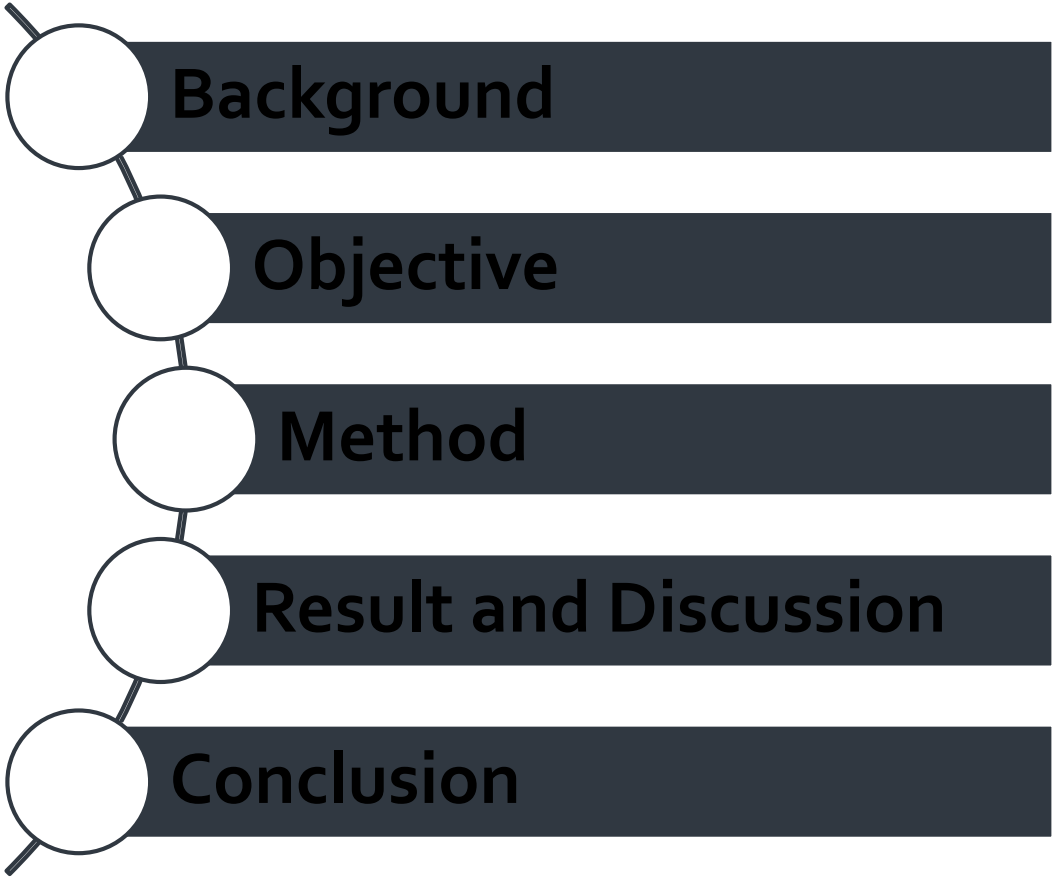
OUTLINE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Background

- One of the biggest sectors contributing in the production of GRK is transportation.
- The provincial government of Central Java is targeting 12.5% CO_2 emission reduction from the transportation sector
- Traffic congestion and frequent stops in the flow of traffic has an impact on the increase of air pollution caused by emissions of motor vehicle exhaust

Background

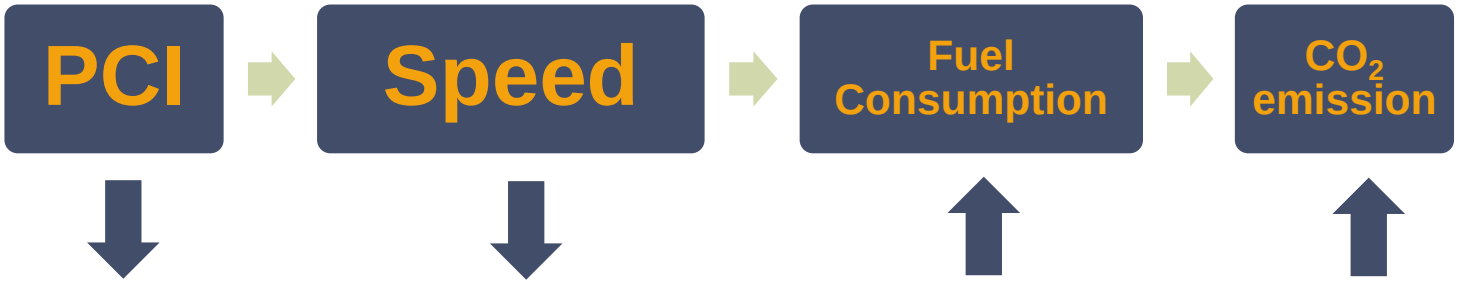
- On the other hand the road roughness, road conditions and horizontal geometric design also affect the speed of vehicles.

  Rougher road surfaces can lead to higher vehicle emissions

  The comparison between very poor road conditions and excellent road conditions indicates a 2.49% increase in average vehicle emissionss on very poor road conditions

  low mean speed produced higher CO_2 emission rates and it increased even more on roads with high speed dispersal

Background



- Due to the fact that road condition affect the speed of vehicles on the road and impact CO_2 emission, further research is needed

Objective

- ✓ This study aims to obtain the relationship between CO_2 emission from vehicle activity and urban road condition.
- ✓ To find out how much carbon CO_2 emission decrease, by raising the value of PCI

Method

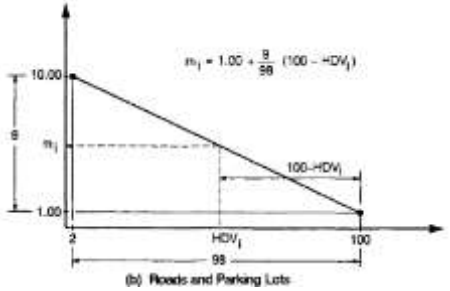
Assessing road condition using the Pavement Condition Index method (PCI)

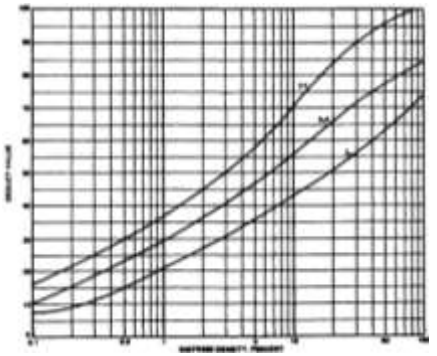
Calculating the fuel consumption of each type of vehicle using the equation of Pacific Consultant International

Calculating CO_2 emissions using the equation from International Panel on Climate Change (IPCC)

Assessment using PCI

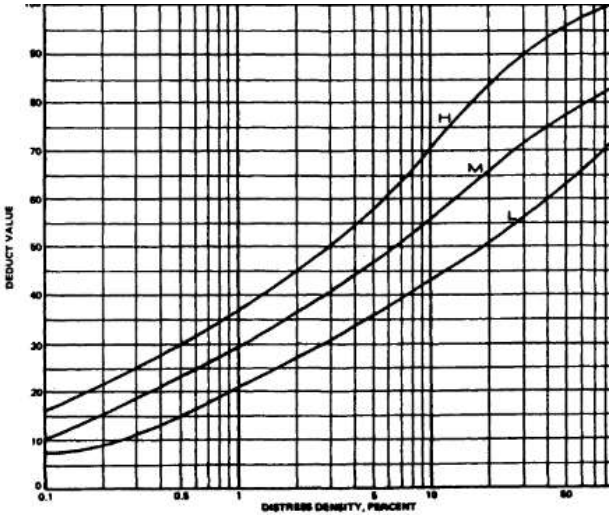
1. Divide the road segment per 100 m on the road of research object,
2. Measurement of the quantity of damage types,
3. Determine the level of road damage that is low , medium, high,
4. Determining the level of damage (density),
5. Determining the deduct value, according to the DV curve reading,





Assessment using PCI (Cont.)

6. Determining the Total Deduct Value (TDV),
7. Determining Corrected Deduct Value (CDV), according to the reading of graphs of TDV and CDV relationships,
8. Determining the PCI value of each segment.



Calculation of fuel consumption

- Calculation of fuel consumption involves a calculation model developed by the Pacific Consultant International
- Travel speed becomes the variable in fuel usage
- The data of travel speed is obtained by a survey using a vehicle model method

Calculation of CO_2 emissions

- To calculate CO_2 emission, some data is required, such as number of vehicles, vehicle type, fuel type, emission factor, and level of fuel consumption for each type of vehicle
- The data on the number and type of vehicles is obtained through manual traffic surveys
- Type of vehicle are grouped into 3 groups of motor vehicles according to MKJI 1997; motorcycle (MC), low vehicle (LV) and heavy vehicle (HV). Low vehicles are divided into two types based on the type of fuel used, namely either diesel or gasoline

Calculation of CO_2 emissions (Cont.)

- The emission factor used in the calculation of CO_2 emissions is the national emission factor according to the Minister of Environment Regulation No. 12/2010 on Air Pollution Control in the Region

Tabel 18 Faktor emisi kendaraan bermotor lama di Indonesia (kategori umum)
Peraturan Menteri Lingkungan Hidup No. 12/2010

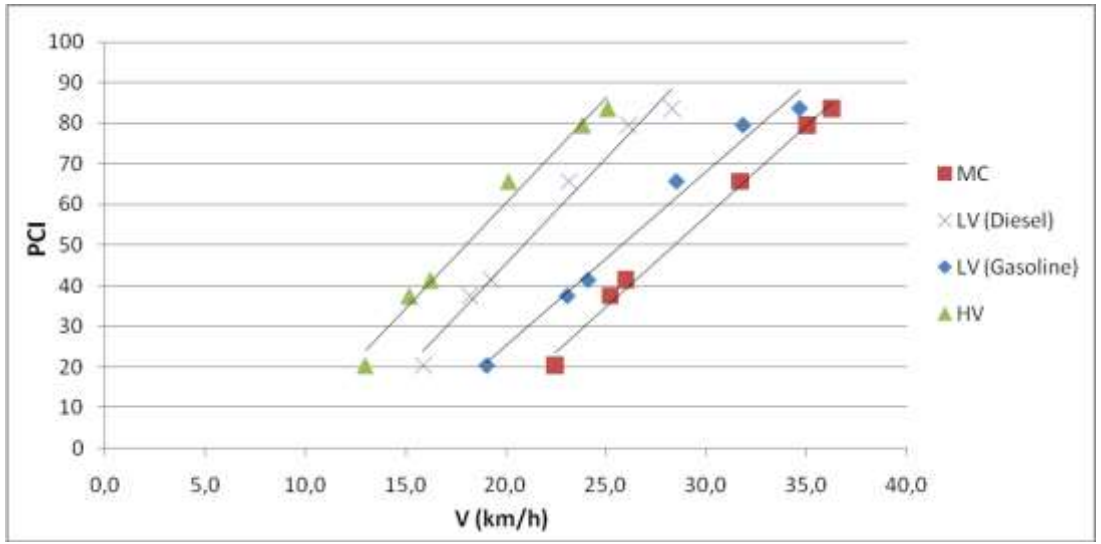
Kategori	CO	HC	NO_x	PM_{10}	CO_2	SO_2
	(g/km)	(g/km)	(g/km)	(g/km)	(g/kg BBM)	(g/km)
Sepeda motor	14	5,9	0,29	0,24	3180	0,008
Mobil penumpang (bensin)	40	4	2	0,01	3180	0,026
Mobil penumpang (solar)	2,8	0,2	3,5	0,53	3172	0,44
Mobil penumpang	32,4	3,2	2,3	0,12	3178	0,11
Bis	11	1,3	11,9	1,4	3172	0,93
Truk	8,4	1,8	17,7	1,4	3172	0,82

Results and Discussions

- **Pavement Condition Index (PCI)**

No	Roads	Length m	width m	PCI Average	Damage levels
1	Jl. Songgom	9200	5	20,4	VERY POOR
2	Jl. Pramuka	1200	5	37,5	POOR
3	Jl. Abimanyu	1000	5	41,4	FAIR
4	Jl. Ahmad Dahlan	1200	5	65,7	GOOD
5	Jl. Ronggowarsito	3500	5	79,5	VERY GOOD
6	Jl. Sultan Agung	2500	6	83,6	VERY GOOD

Impact of Road Damage on Travel Speed



All types of vehicles show a relationship between road damage and their speed of travel.

There is an up to 57% decrease of speed on very poor road conditions compared to on very good road conditions

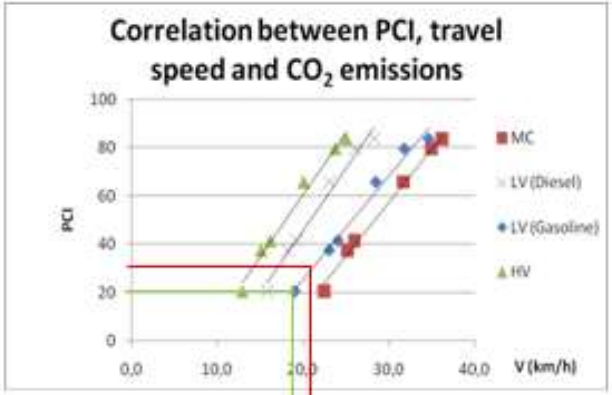
Correlation of road condition and CO_2 emissions

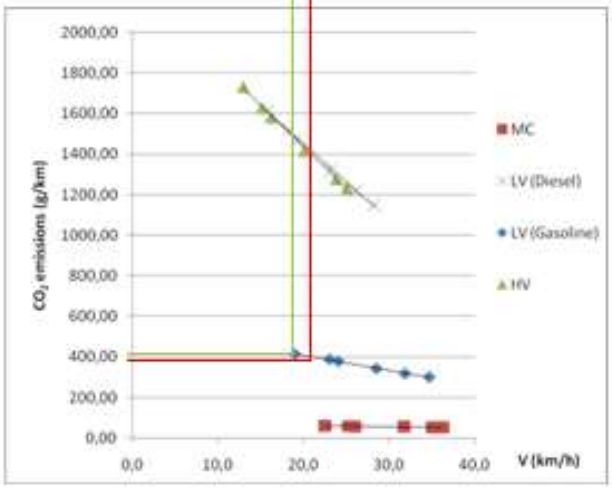
Roads	PCI	$V_{average}$ (km/h)	fuel cons. (lt/km)	CO_2 emissions (g/km)				Average (g/km)
				MC	LV Gasoline	LV Diesel	HV	
Jl. Songgom	20,4	17,6	0,376	60,80	412,60	1617,79	1732,07	955,81
Jl. Pramuka	37,5	20,4	0,353	58,19	388,89	1517,06	1629,29	898,36
Jl. Abimanyu	41,4	21,4	0,343	57,30	378,73	1473,90	1581,94	872,97
Jl. Ahmad Dahlan	65,7	25,9	0,309	55,31	343,23	1323,41	1417,88	784,96
Jl. Ronggowarsito	79,5	29,2	0,282	52,03	318,65	1219,50	1277,72	716,98
Jl. Sultan Agung	83,6	31,1	0,269	51,54	302,24	1150,23	1233,68	684,42

The relationship between speed of travel and fuel consumption is inversely proportional. Fast-moving vehicles will consume less fuel.

Fuel consumption of each type of vehicle certainly affects the resulting CO_2 emissions. High fuel consumption levels will result in high CO_2 emissions as well.

Correlation of road condition and CO_2 emissions (Cont.)





Increasing the value of PCI by 10 points from the lowest value will reduce CO_2 emissionss by 3.36% for gasoline-fueled vehicles.

Conclusion

- There is a correlation between road conditions, travel speed and production of CO_2 emissions by vehicles.Road damage can affect the travel speed of vehicles.
- Very poor road conditions led to a 57% reduction in travel speed compared to very good road conditions.

Conclusion (Cont.)

- The decrease in speed leads to an increase in fuel consumption. Higher fuel consumption will cause higher CO_2 emissions as well.
- Increasing the value of PCI by 10 points from the lowest value will reduce CO_2 emissions by 3.36% for gasoline-fueled vehicles.

Thank You