


Coordinated Highways Action Response Team

Performance Evaluation and Benefit Analysis for Year 2018

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State Highway Administration

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PART A: Performance Evaluation

Part A: Performance Evaluation

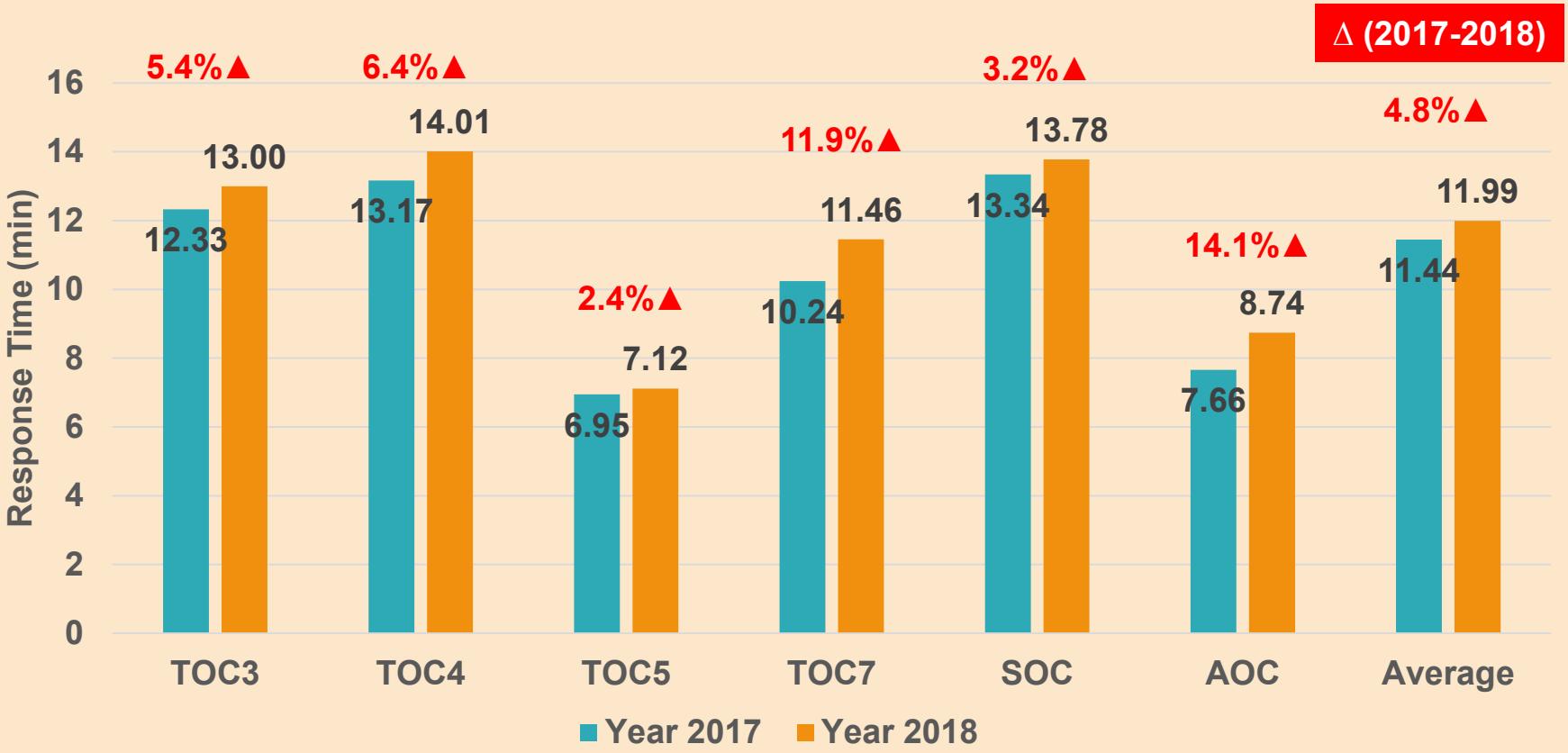
Total Number of Incidents/Disabled Vehicle Assists

	Incidents	Disabled Vehicle Assist	Total Records
2014	31,535 (25,571)	46,330 (45,228)	77,865 (70,799)
2015	35,119 (27,375)	42,724 (40,615)	77,843 (67,990)
2016	37,566 (30,314)	44,287 (42,048)	81,853 (72,362)
2017	37,100 (30,335)	44,199 (42,046)	81,299 (72,381)
2018 *Responded by CHART*	**41,247** **(34,692)** *84.11%*	**46,891** **(45,264)** *96.53%*	**88,138** **(79,956)** *90.72%*
Δ (2017-2018)	***11.18%*** ***(14.36%)***	***6.1%*** ***(7.7%)***	***8.41%*** ***(10.47%)***

- This analysis is based on emergency response records in CHART DB.
- Number in the parenthesis shows the incidents or assists responded by CHART.

Part A: Response Time (RT)

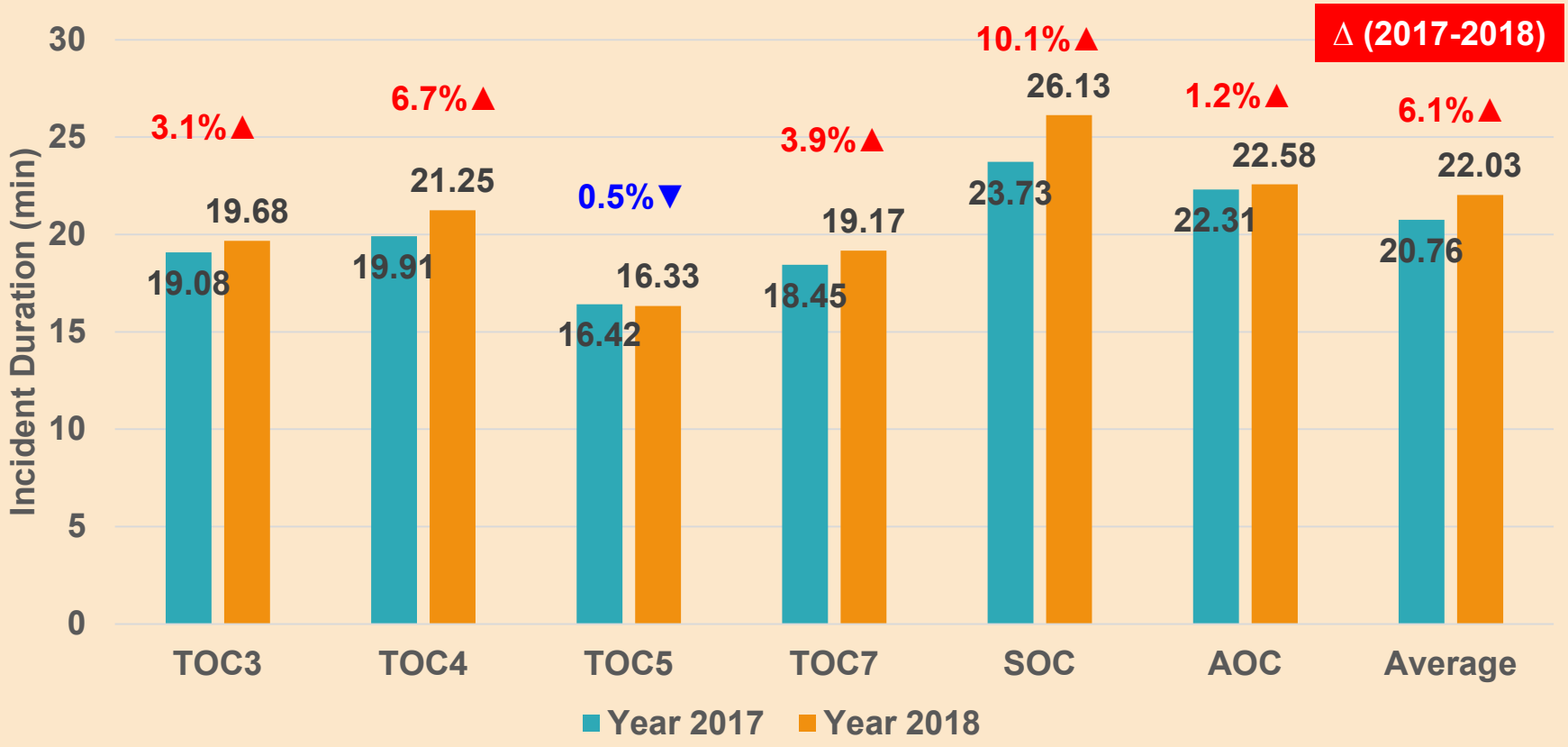
❑ Response Time to Incident/Dis_Vehs By Center



- This analysis is based on the data of incidents and disabled vehicles which have indicated the responsible operation center and response times.
- This analysis includes those sample events which have response times between 1 minute and 60 minutes
- Events included in this analysis were responded by various units, including CHART, fire boards, stat/local polices, private towing companies, etc.
- TOC-3 has been temporarily closed and relocated to SOC since August 2018.

Part A: Incident Durations (ID)

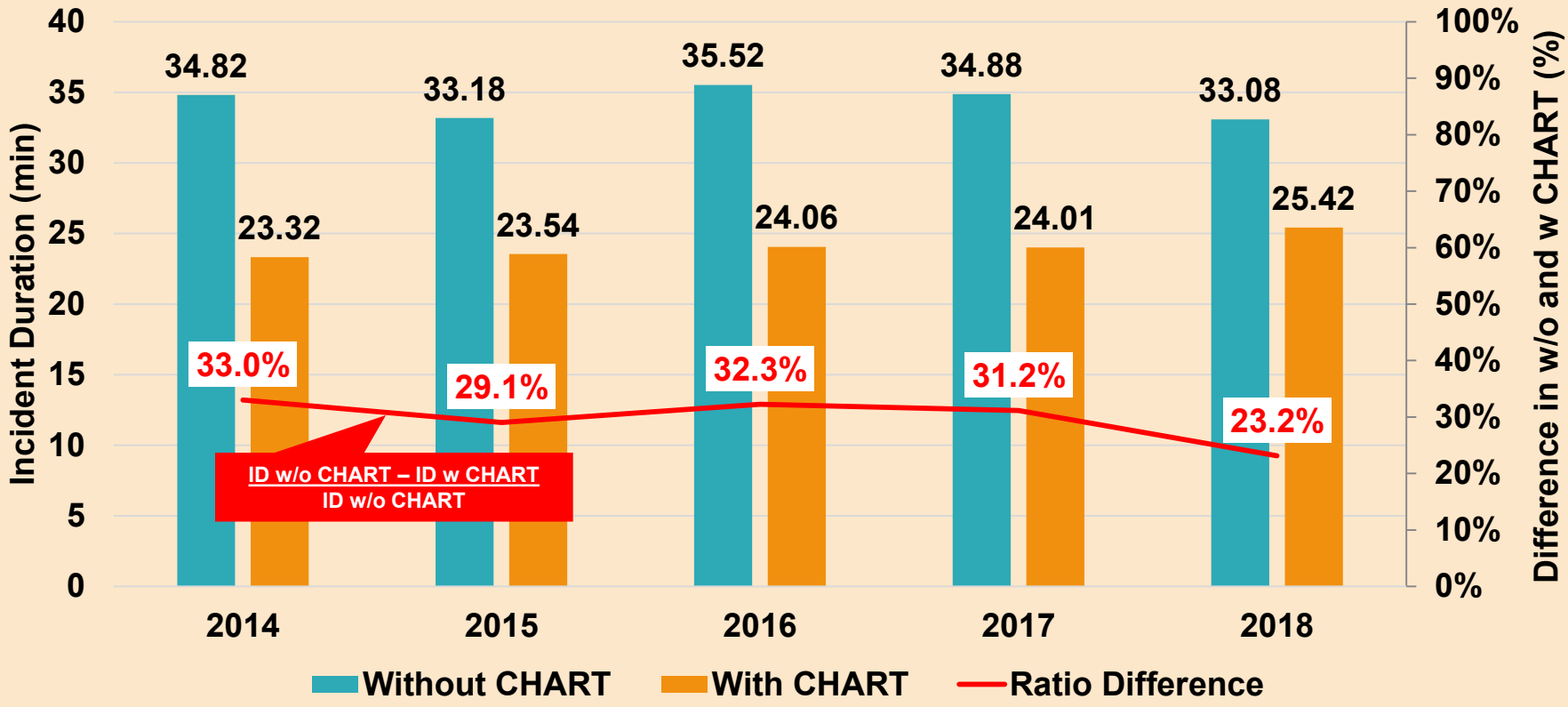
❑ Incident Duration By Center



- This analysis is based on incident records which have indicated the responsible operation center and response times.
- This analysis includes those sample events which have incident durations between 1 minute and 120 minutes

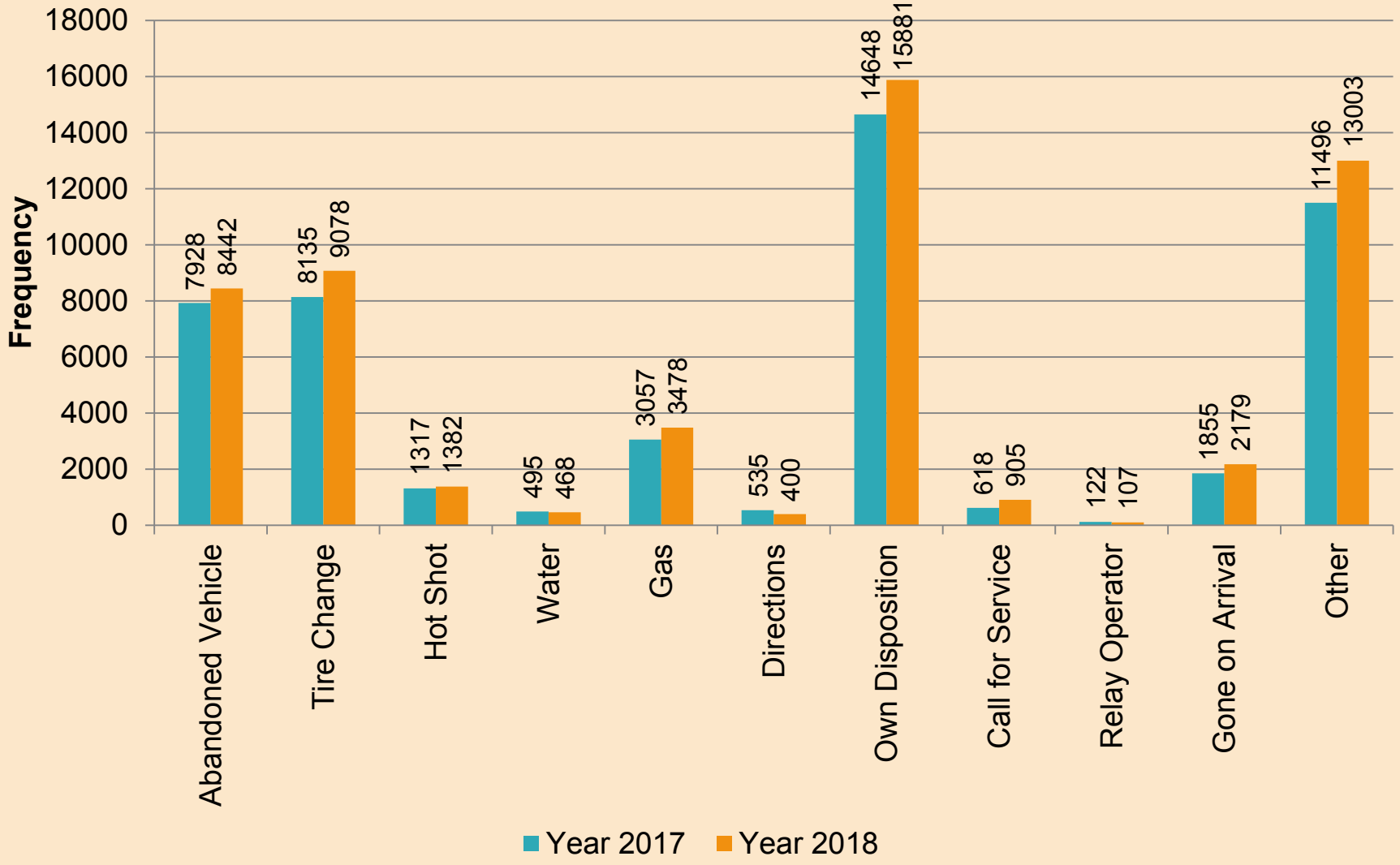
Part A: Incident Durations (ID)

With CHART vs. without CHART



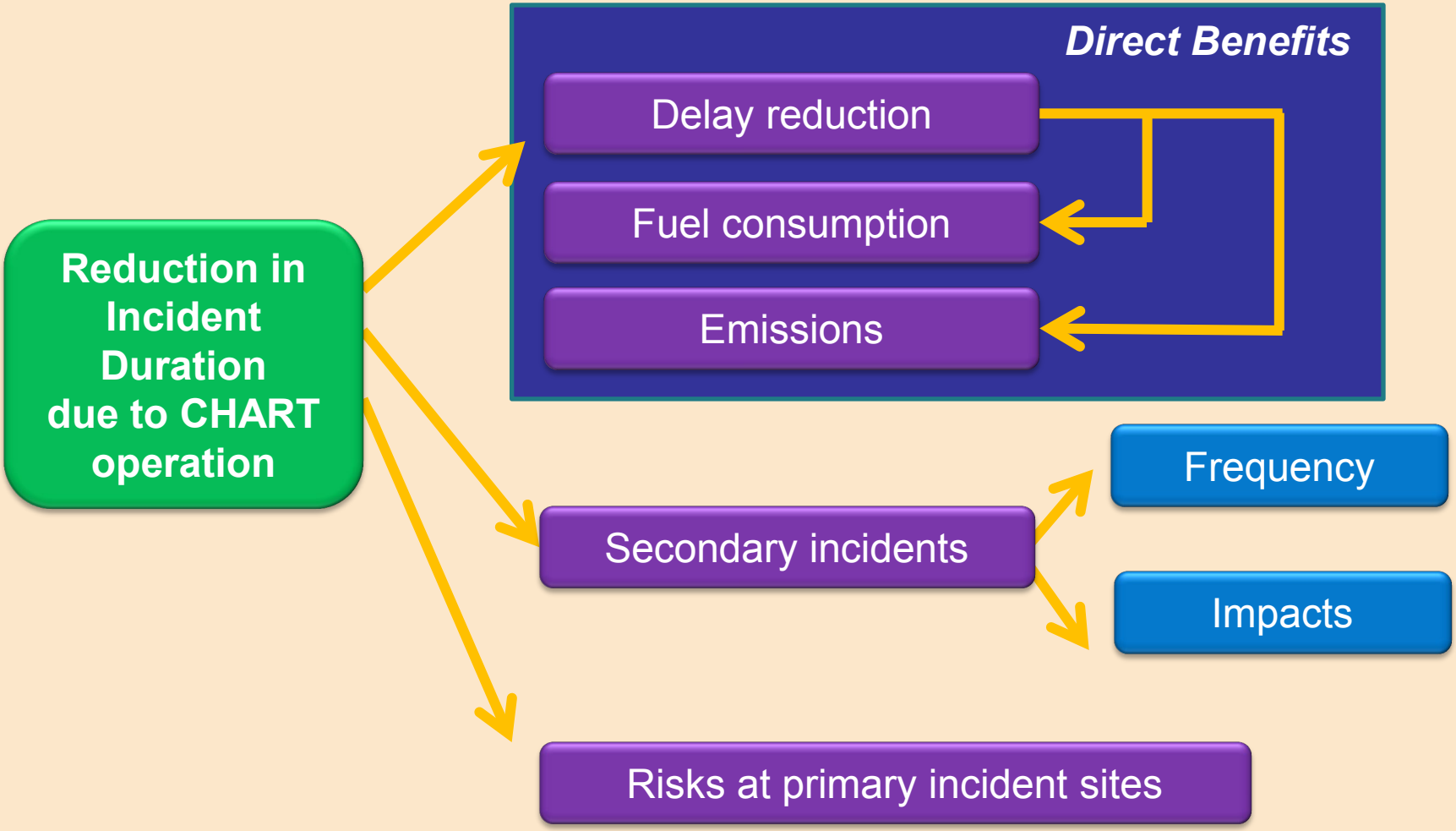
- This analysis is based **on incident records** which have included the information of event, duration, lane blockage, and response units.
- This analysis includes those sample events which have incident durations between 1 minute and 120 minutes
- Cases of “Unknown” blockage were redistributed into different blockage categories.
- The numbers are the weighed average of incidents with different lane blockages, including shoulder only blockage

Part A: Assistance to Drivers



PART B: Benefit Estimation

Part B: Benefit Estimation



Part B: Benefit Estimation

Procedures

- Step 1: Gather information (incident data, traffic data, etc.)
- Step 2: Estimate **the total delay by segment for each major road**
- Step 3: Estimate **the total delay for major roads**
- Step 4: Estimate **the total delay for all roads** in Maryland
- Step 5: Estimate **the total delay reduction** due to CHART operations
- Step 6: Estimate **the reduction in fuel consumption and emissions**
- Step 7: Convert the reduction into the **monetary values**

Part B: Delay Reduction Estimation

- **Step 1:** Gather Information
  - Incident Data from CHART DB II
    - Frequency
    - Incident duration
    - Lane blockage
    - CHART involvement, etc.
  - AADT, Peak Hour Factor, Truck % for major roads in MD
  - Income, Gas Price, etc.

Part B: Delay Reduction Estimation

- **Step 2:** Estimate **the total delay by segment for each major road**
  - **Simulate** the entire highway segment
  - **Develop the *Delay function***

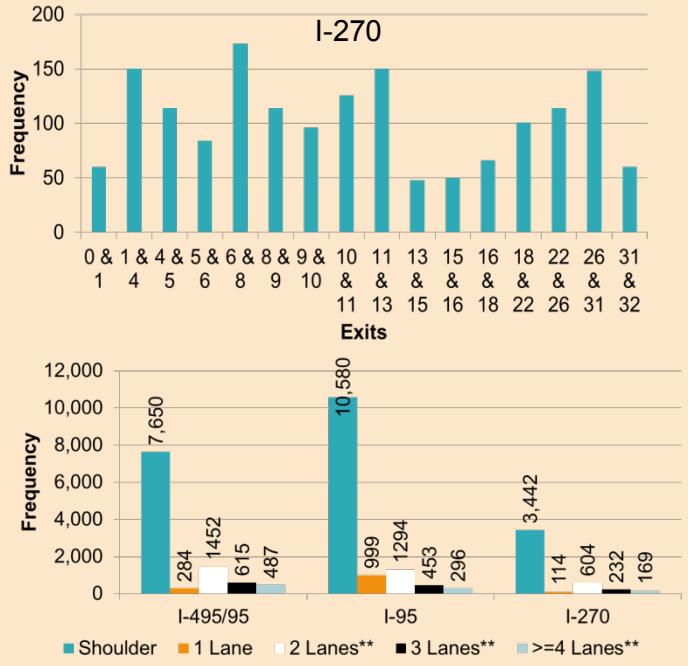
(**I-Delay**) = f(Incident duration, traffic volume, No. of lane blockage, total No. of lanes, etc.)

Part B: Delay Reduction Estimation

❖ **Step 2:** Estimate **the total delay by segment for each major road**

Input

Distribution of incidents by **segment** of each road and **lane blockage**



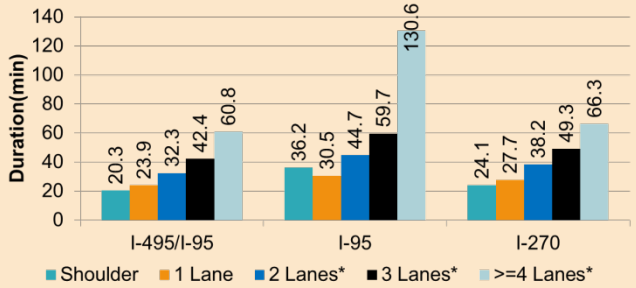
Part B: Delay Reduction Estimation

❖ **Step 2:** Estimate **the total delay by segment for each major road**

Input

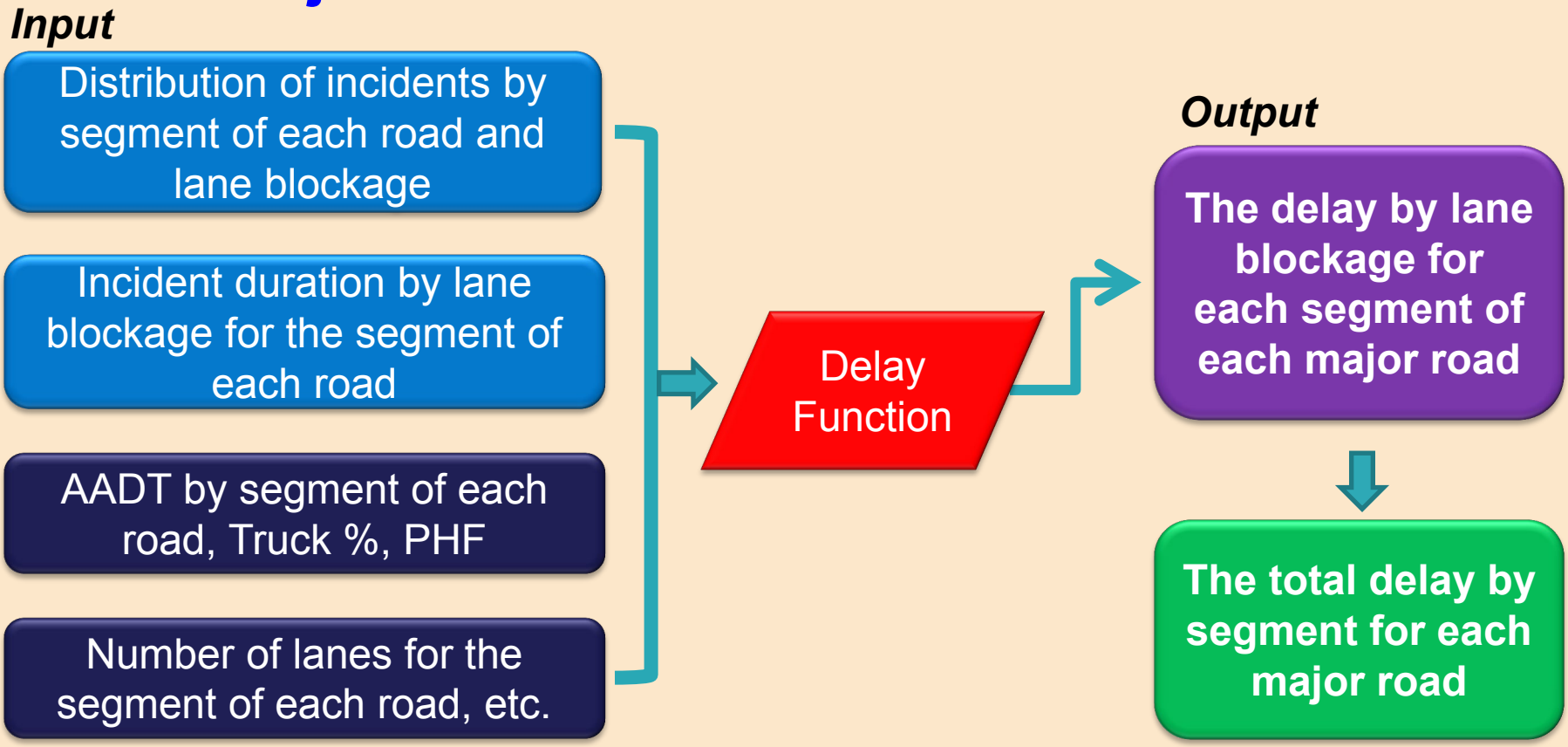
Distribution of incidents by segment of each road and lane blockage

Incident duration by lane blockage for the segment of each road



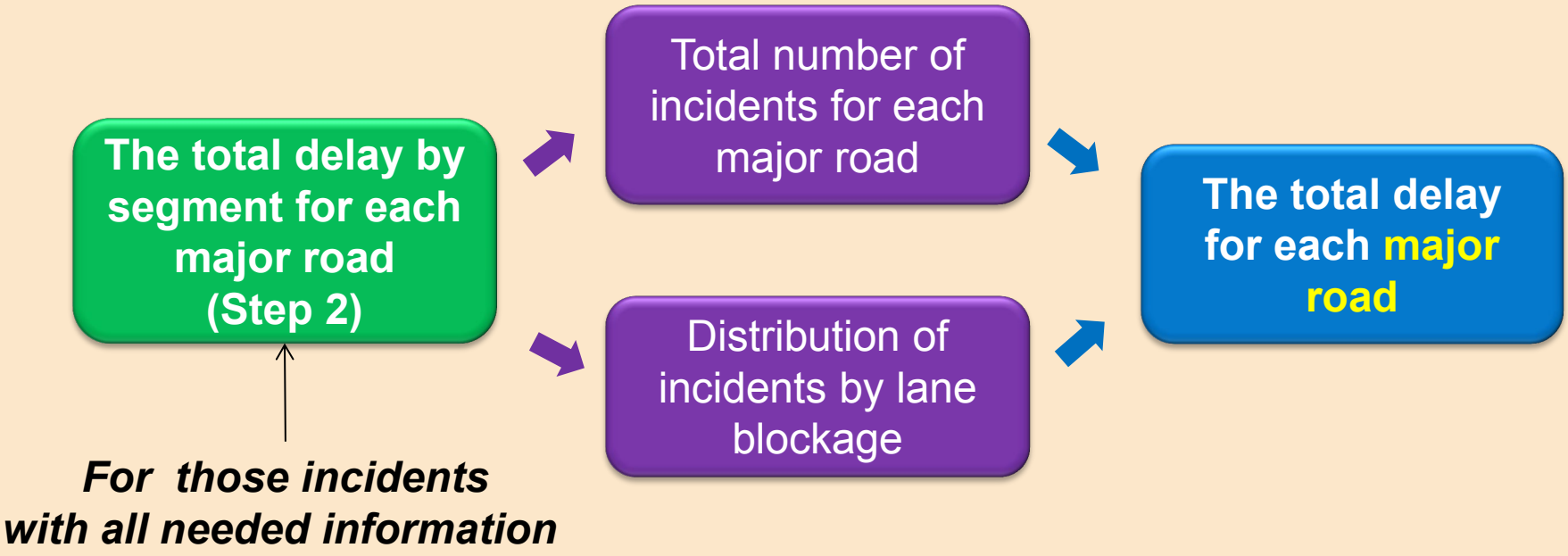
Part B: Delay Reduction Estimation

❖ **Step 2:** Estimate **the total delay by segment for each major road**



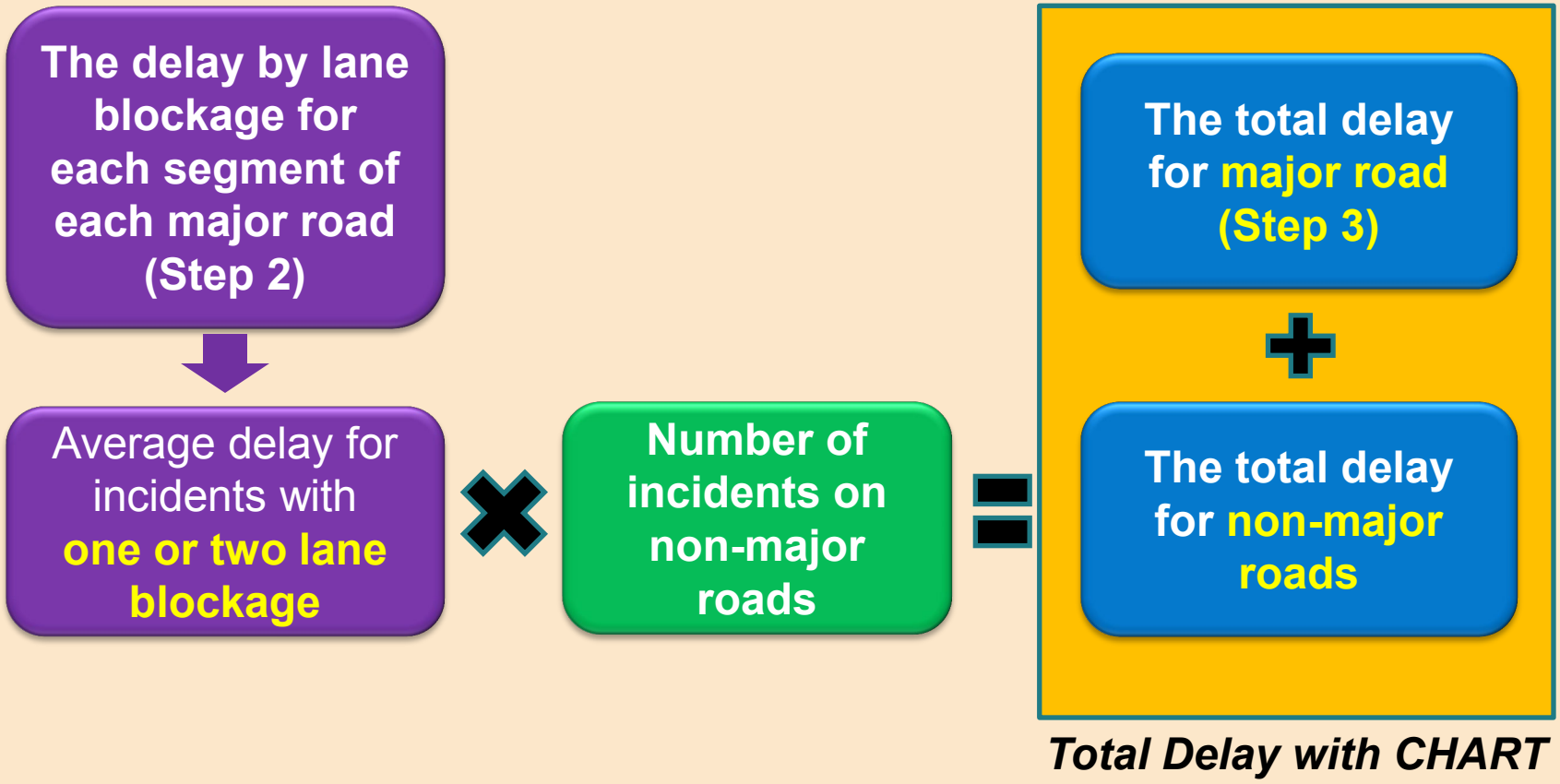
Part B: Delay Reduction Estimation

❖ **Step 3:** Estimate **the total delay for major roads**



Part B: Delay Reduction Estimation

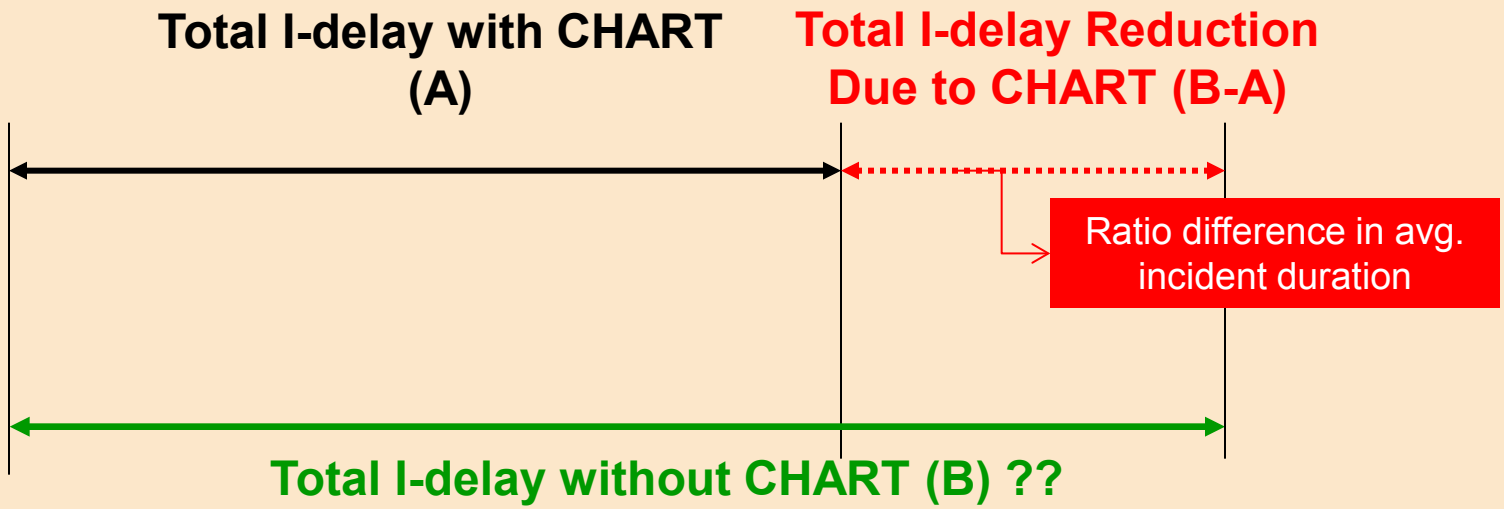
❖ **Step 4:** Estimate **the total delay for all roads** in MD



Part B: Delay Reduction Estimation

- **Step 5**: Estimate **the total delay reduction** due to CHART operations

Delay reduction due to CHART:= $(T\text{-}Delay)_{w/o\ CHART} - (T\text{-}Delay)_{w\ CHART}$



Part B: Ratio Difference in IDs

❑ Incident Durations: w CHART and w/o CHART

Distributed to SH & 1 lane blockage

Blockage		With CHART Duration	With CHART Frequency
Shoulder (SH)		22.79	4,633
1 lane		26.30	8,813
2 lanes		37.80	2,728
3 lanes		43.56	777
>=4 lanes		46.93	363
Unknown		18.72	7,661
Weighted Average	w/o SH	30.42	12,681
	All	25.42	24,975

Blockage		With CHART Duration	With CHART Frequency
Shoulder (SH)		21.32	7,273
1 lane		23.55	13,834
2 lanes		37.80	2,728
3 lanes		43.56	777
>=4 lanes		46.93	363
Unknown			
Weighted Average	w/o SH	27.10	17,702
	All	25.42	24,975

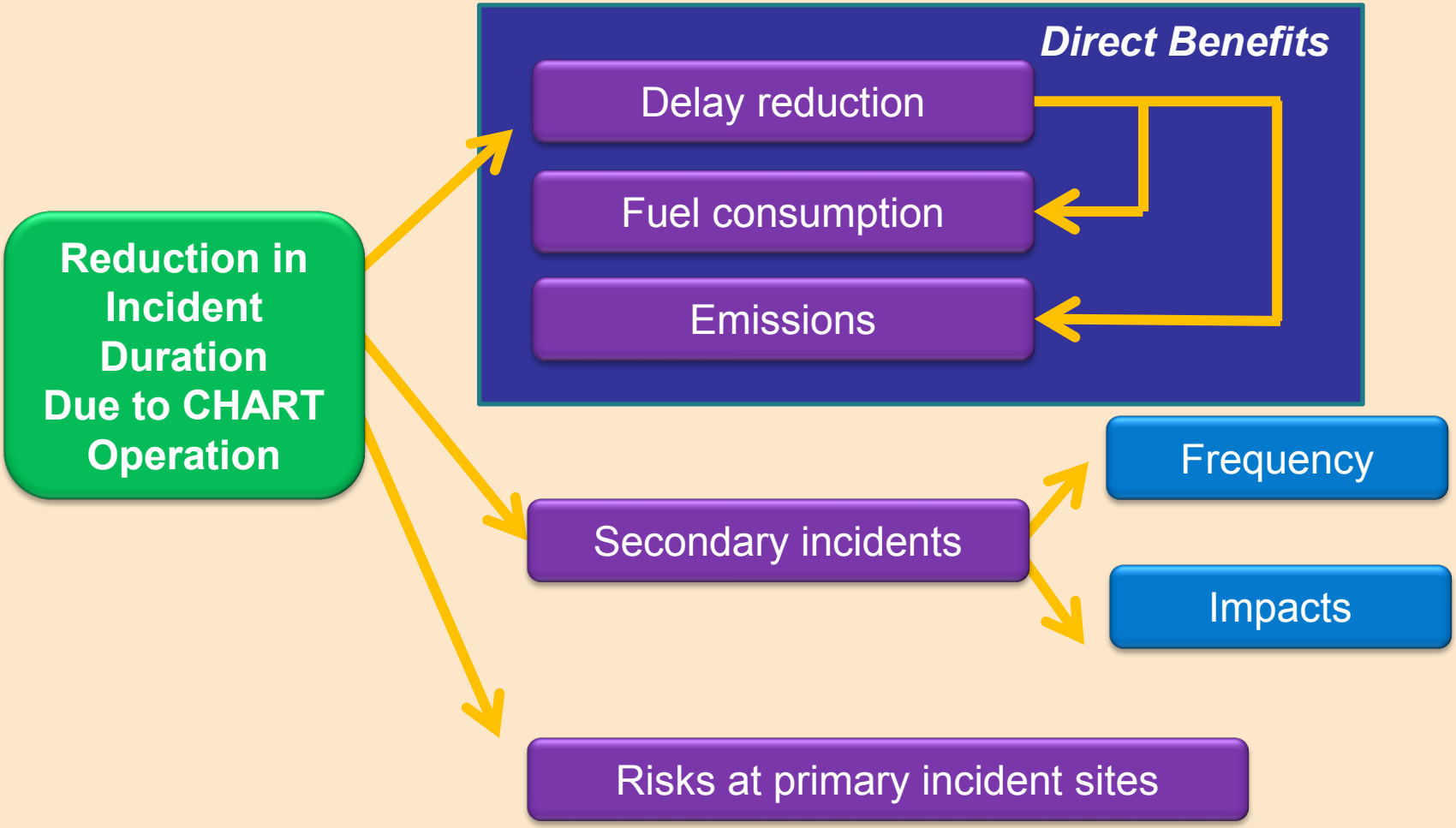
Distributed to SH & 1 lane blockage

Blockage		Without CHART Duration	Without CHART Frequency
Shoulder (SH)		30.75	577
1 lane		34.53	544
2 lanes		42.44	201
3 lanes		53.38	61
>=4 lanes		62.71	20
Unknown		30.78	1,374
Weighted Average	w/o SH	38.53	826
	All	33.08	2,777

Blockage		Without CHART Duration	Without CHART Frequency
Shoulder (SH)		30.77	1,284
1 lane		32.47	1,211
2 lanes		42.44	201
3 lanes		53.38	61
>=4 lanes		62.71	20
Unknown			
Weighted Average	w/o SH	35.07	1,493
	All	33.08	2,777

Ratio difference in ID: (35.07-27.10)/35.0=22.73%

Part B: Benefit Estimation



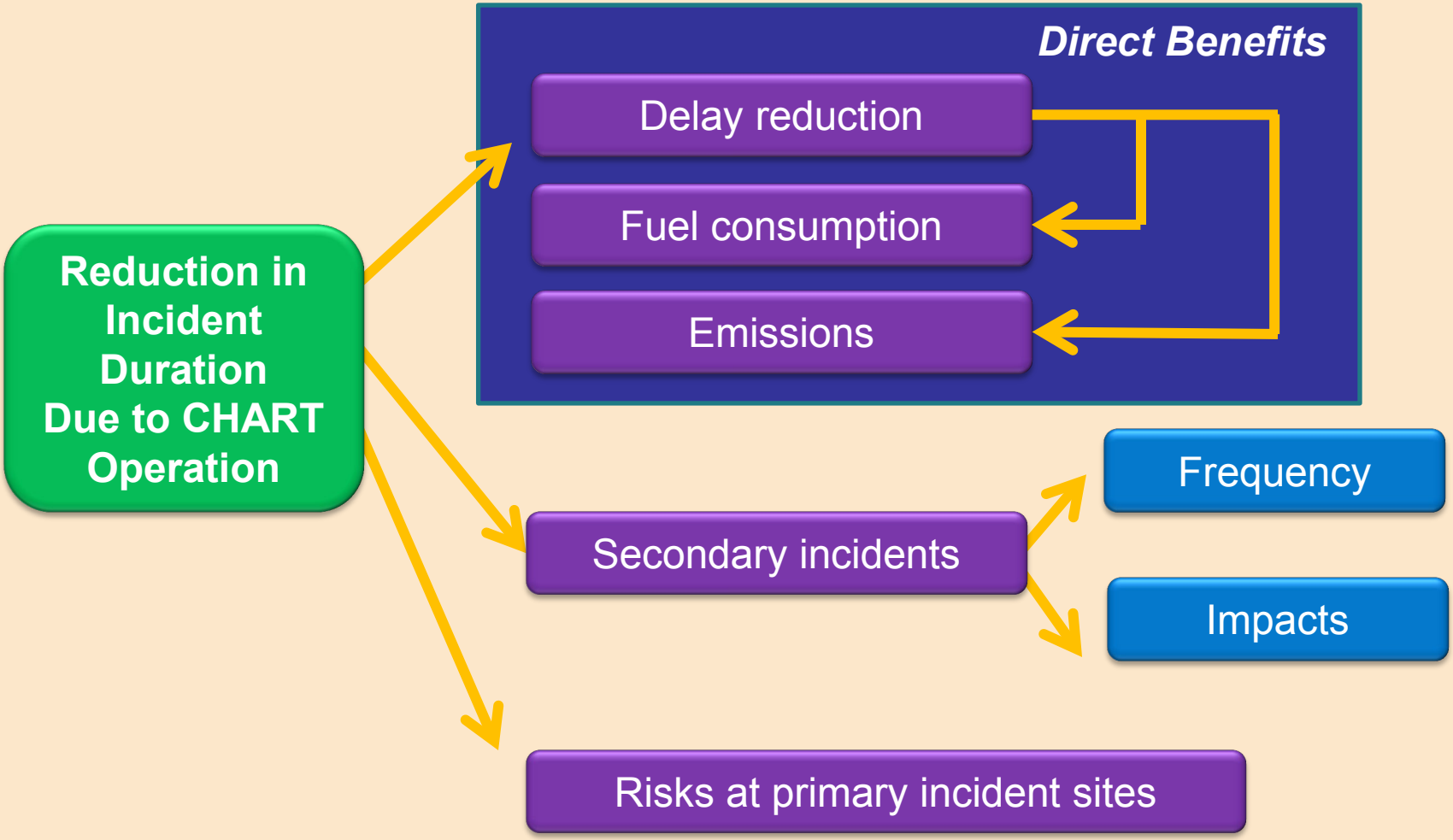
Part B: Fuel Consumption

- Estimate Reduction in Fuel Consumption
  - Method 1: from the results of simulation

$$\Delta Fuel = e^{-10.77} * (Traffic\ Volume)^{2.27} * \left(\frac{No.\ of\ Lane\ Blocked}{Total\ No.\ of\ Lanes}\right)^{0.9} * (Incident\ Duration)^{1.69}$$

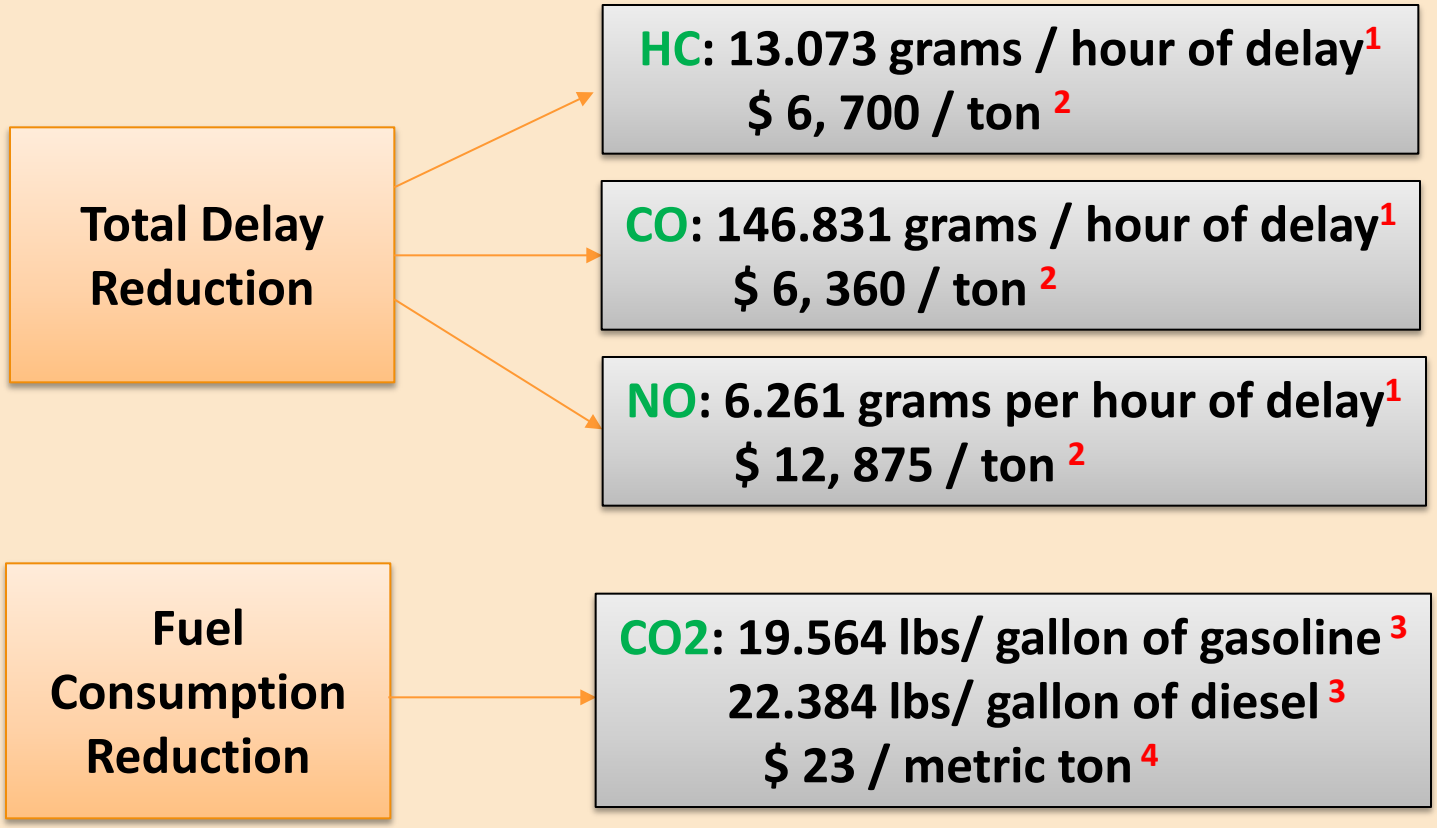
  - **Method 2: conversion from the total delay reduction**

Part B: Benefit Estimation



Part B: Emission Reduction

- Estimate Reduction in Emission



1. MDOT in Year 2000
2. Literature (DeCorla-Souza, 1998)
3. Energy Information Administration
4. Congressional Budget Office for S. 2191, America's Climate Security Act of 2007

Part B: Benefit Estimation

- **References for converting the reduction into the monetary values**
  - *Truck driver's unit cost is based on the information from the Bureau of Labor Statistics in year 2018.*
  - *Car driver's unit cost is based on household income by the U.S. Census Bureau (2018).*
  - *The gasoline and diesel unit costs are from the Energy Information Administration in year 2018.*
  - *The fuel consumption was computed based on the rate of 0.156 gallons of gas per hour for passenger cars from the Ohio Air Quality Development Authority and the rate of 0.85 gallon per hour for trucks from the literature "Heavy-Duty Truck Idling Characteristics-Results from a Nationwide Truck Survey" by Lutsey et al. and the Environmental Protection Agency (EPA).*
  - *The unit rates of 19.56 lbs CO2/gallon of gasoline and 22.38 lbs CO2/gallon of diesel are from the Energy Information Administration and $23/metric ton of CO2 from CBO (Congressional Budget Office)'s cost estimate for S. 2191, America's Climate Security Act of 2007.*

Part B: Benefit Estimation

❑ Direct Benefits in Year 2018 (Year 2017)

Reduction due to CHART		Amount	Unit rate	Dollars (million)
Delay (M veh-hrs)	Truck	**1.51** (1.64)	DRIVER: **$21.18/hr** (20.79)	**32.09** (34.09)
			CARGO: **$45.40/hr**	**68.68** (74.45)
	Car	**30.75** (29.57)	**$36.94/hr** (34.99)	**1,155.87** (1,294.01)
Fuel Consumption (M gallons)		**6.23** (6.39)	GASOLINE: **$2.82/gal** (2.53) DIESEL: **$3.18/gal** (2.65)	**17.84** (19.01)
Emission (tons)	HC	**428.88** (504.92)	**$6,700/ton**	**37.45** (44.07)
	CO	**4,816.98** (5,671.12)	**$6,360/ton**	
	NO	**205.40** (241.82)	**$12,875/ton**	
	CO_2	**56,382.46** (565,355.70)	**$23/metric ton**[3]	
Total (M dollars)		**1,311.89** (1,465.62)		

- The number in each parenthesis is the data in year 2017.
- All values are rounded to the nearest hundredth in this table only for the presentation purpose, since the actual values need more spaces to be presented. For example, the benefit from truck drivers = 15,128,829.2394 veh-hr * $21.18/hr = $ 320,428,603.29…

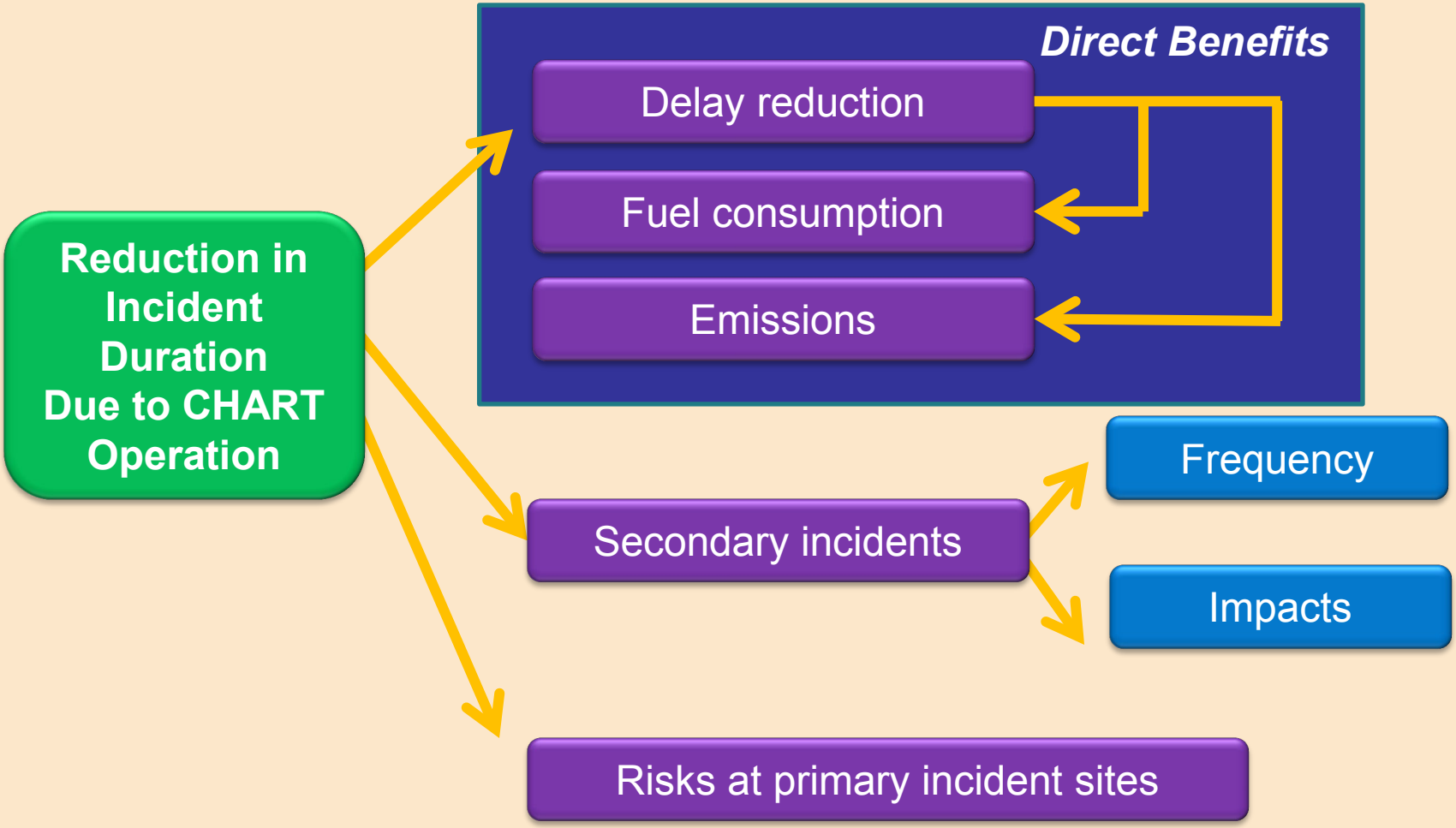
Part B: Sensitivity Analysis

- Computing **the marginal impacts of each key factor**, using its 2018 value, but setting all other factors identical to those in 2017
- **Key factors**
  - Total Number of Incidents Eligible for Benefit Estimate
  - Average Incident Durations with and without CHART
  - The adjusted AADTs (with PHF) for Major Roads
  - Truck Percentages for Major Roads

(million dollars)

Benefits of the Previous Year (2017)			1,465.62
Key Factor		**Δ ('17 - '18)**	**Benefit Estimates**
Sensitivity Analysis	Number of incidents	↑ 10.86 %	**1,580.05(↑ 7.81%)**
	Incident duration difference between w/ and w/o CHART	↓ 28.24 %	**1,111.22(↓24.18%)**
	Adjusted AADT	↓ 0.31 %	**1,467.59(↑ 0.13%)**
	Truck percentage	↑ 1.57 %	**1,465.87(↑ 0.02%)**
Benefits of the Current Year (2018)			**1,311.89 (↓ 10.49%)**

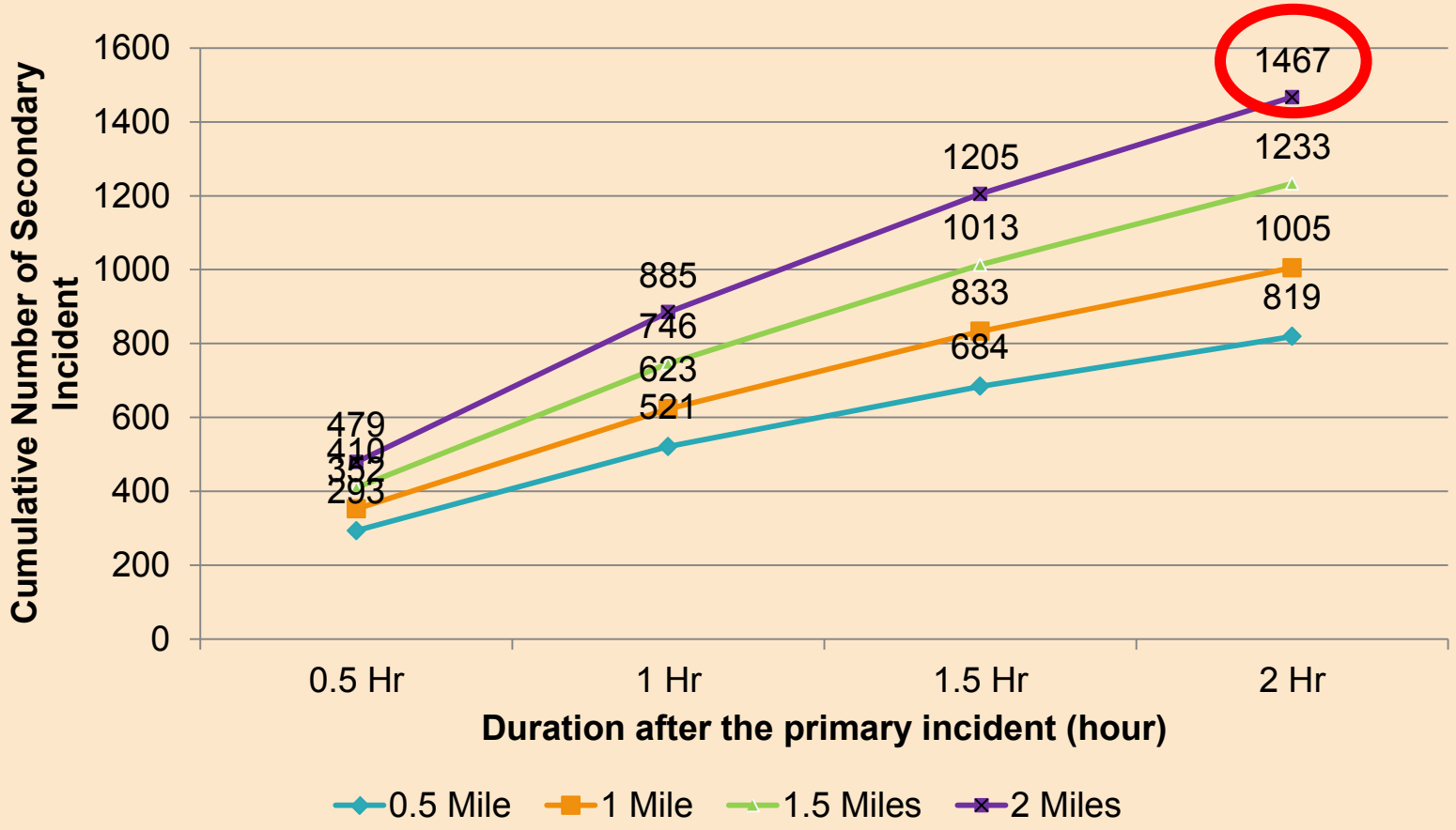
Part B: Benefit Estimation



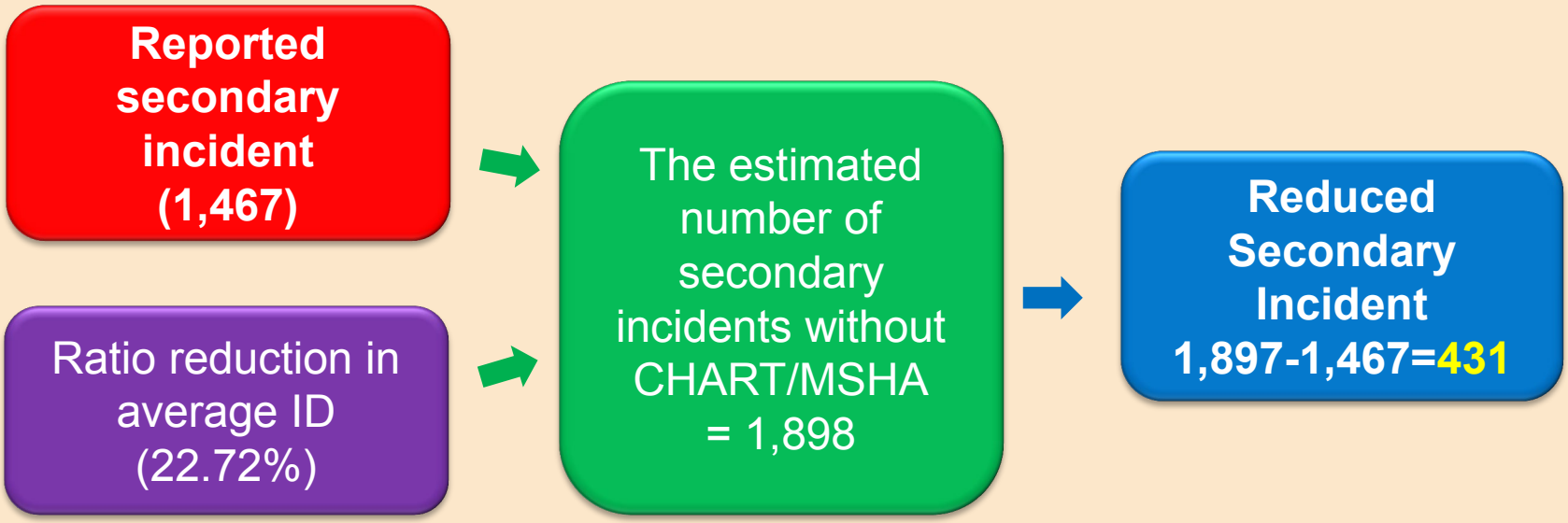
Part B: Secondary Incidents

- Secondary Incidents in Year 2018

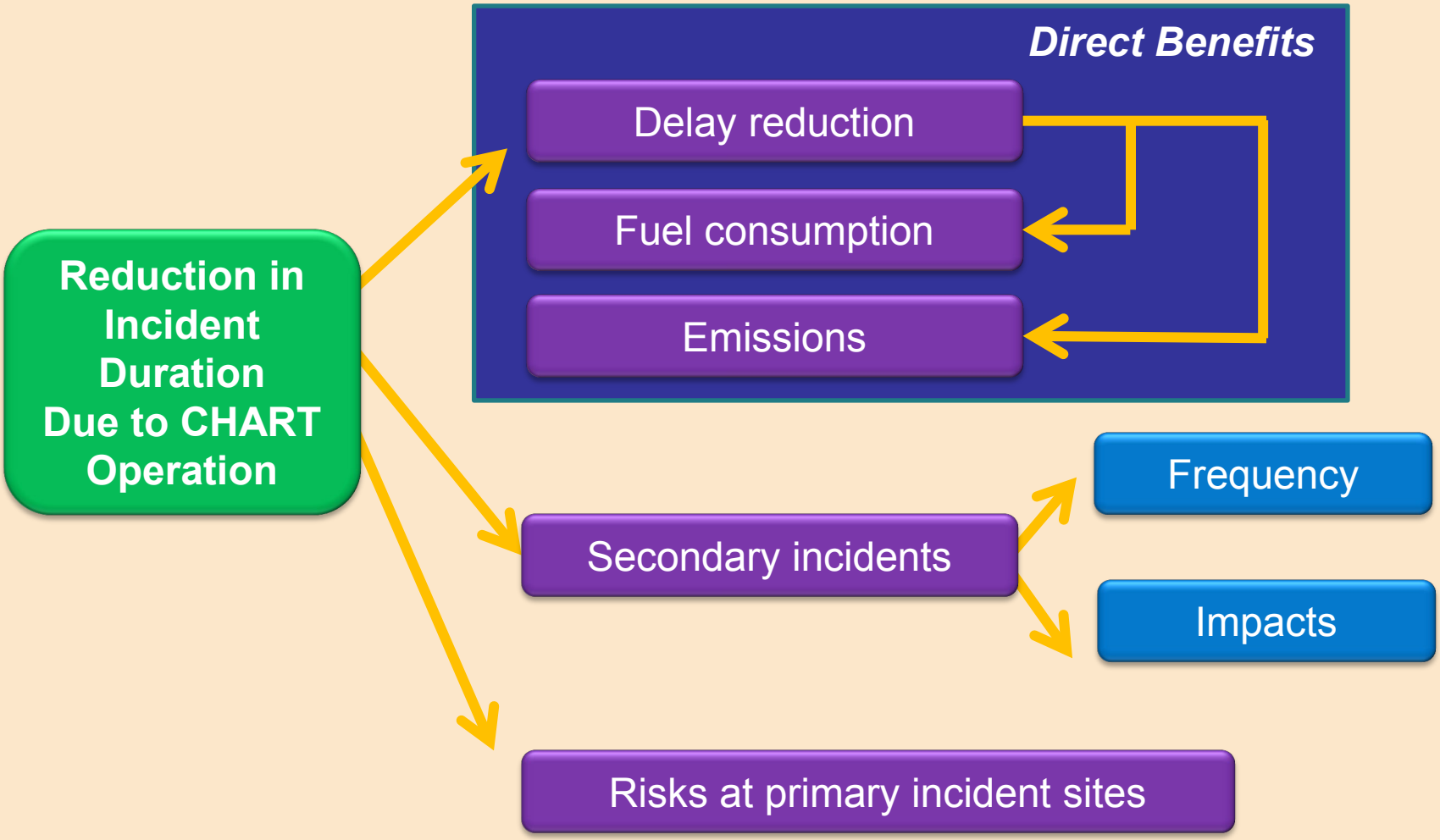
Reported number of secondary incidents



Part B: Secondary Incidents

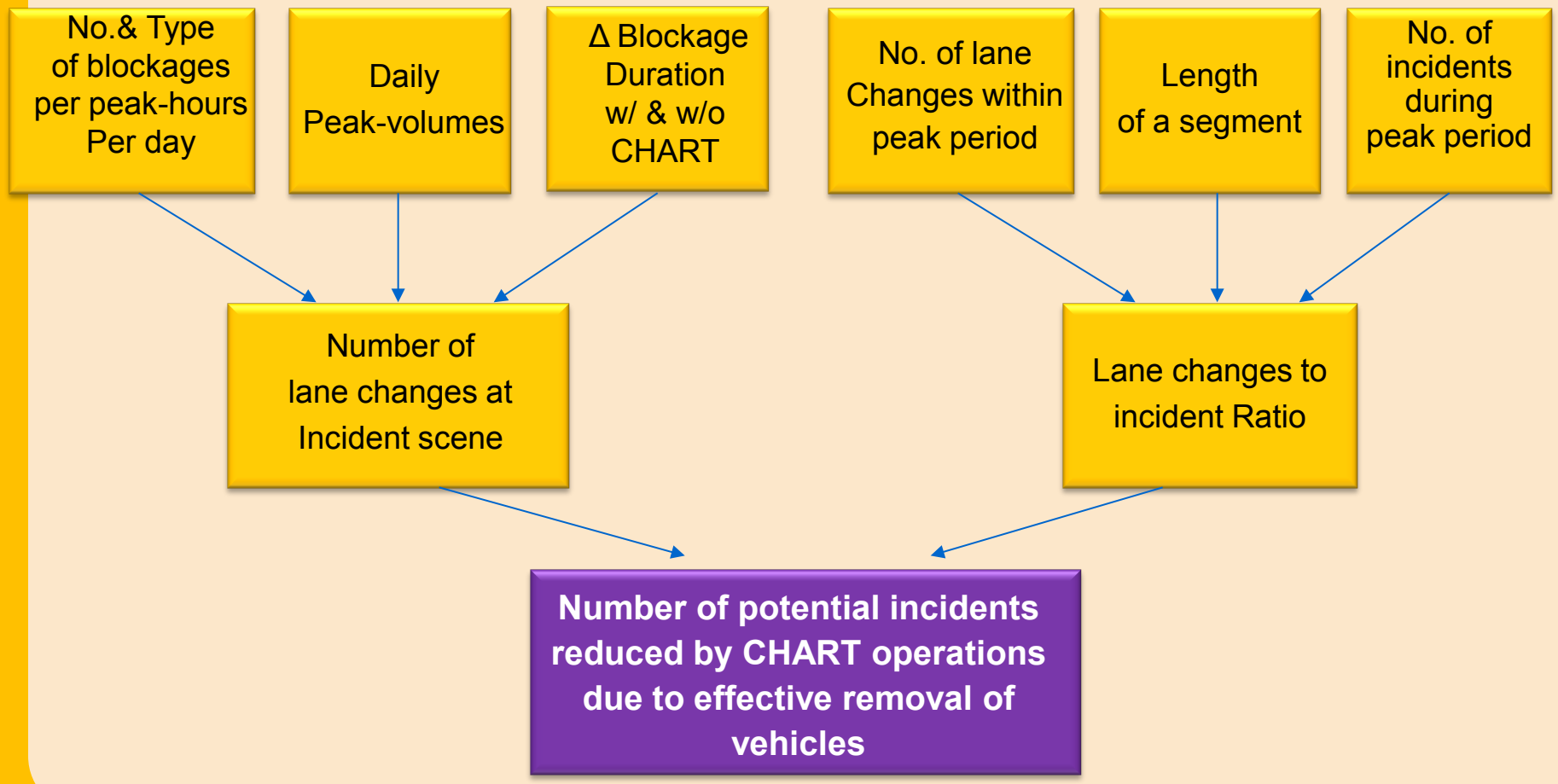


Part B: Benefit Estimation



Part B: Potential Incidents

Risks at primary incident sites



Part B: Potential Incidents

- Potentially reduced Incidents due to CHART Operations

Road Name		I-495/95	I-95	I-270	I-695	I-70	I-83	MD-295	US-50	Total
Mileage		41	63	32	44	13	34	30	42	
No. Potential reduced Incidents	2018	173	231	57	184	74	33	28	69	849
	2017	229	212	62	207	79	45	23	98	955
	2016	228	264	58	223	88	47	29	94	1,031
	2015	185	213	45	161	60	34	24	75	797
	2014	203	231	48	149	72	44	30	71	848


Thank you

Questions?

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