

# RETURN ON INVESTMENT OF CONNECTED VEHICLES CONSIDERING ROADWAY SAFETY IMPACTS



Mahmoud Arafat, Graduate Research Assistant  
 Dr. Mohammed Hadi, Professor, Ph.D., P.E  
 Department of Civil and Environmental Engineering, Florida International University, Miami, FL 33174

## INTRODUCTION

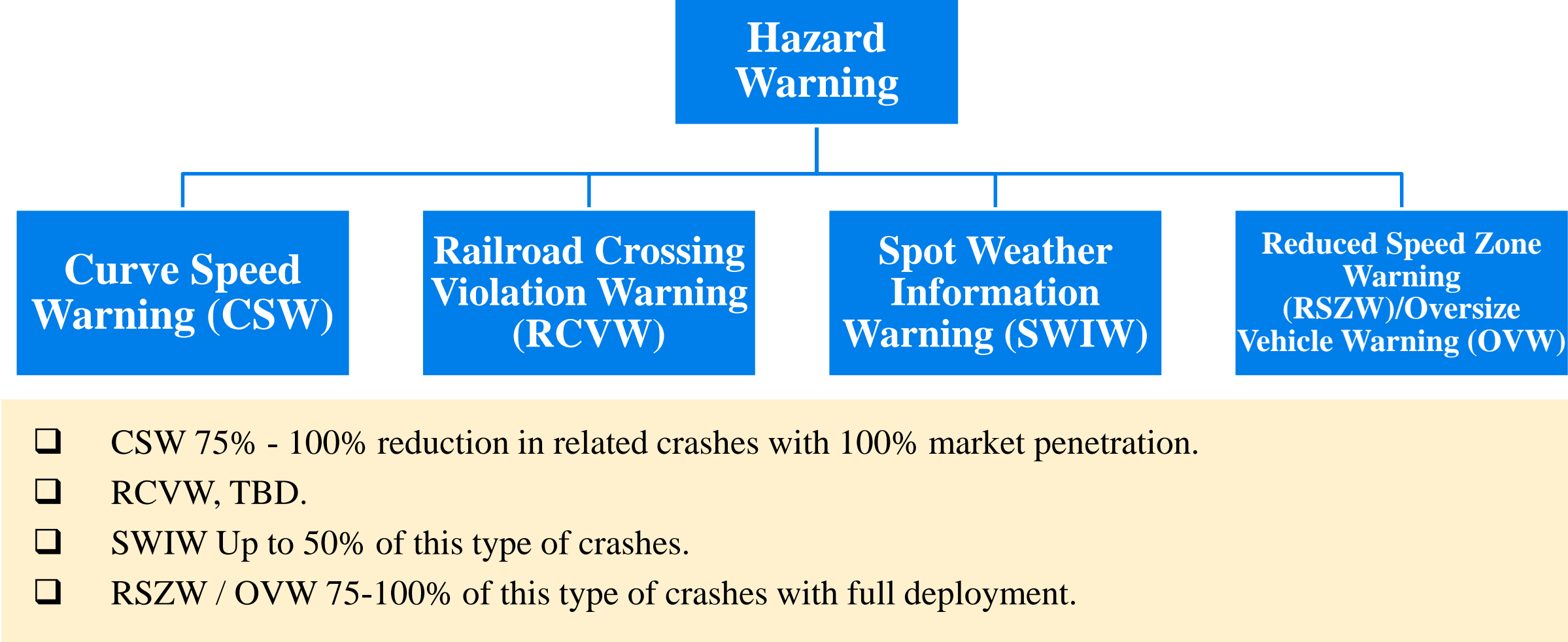
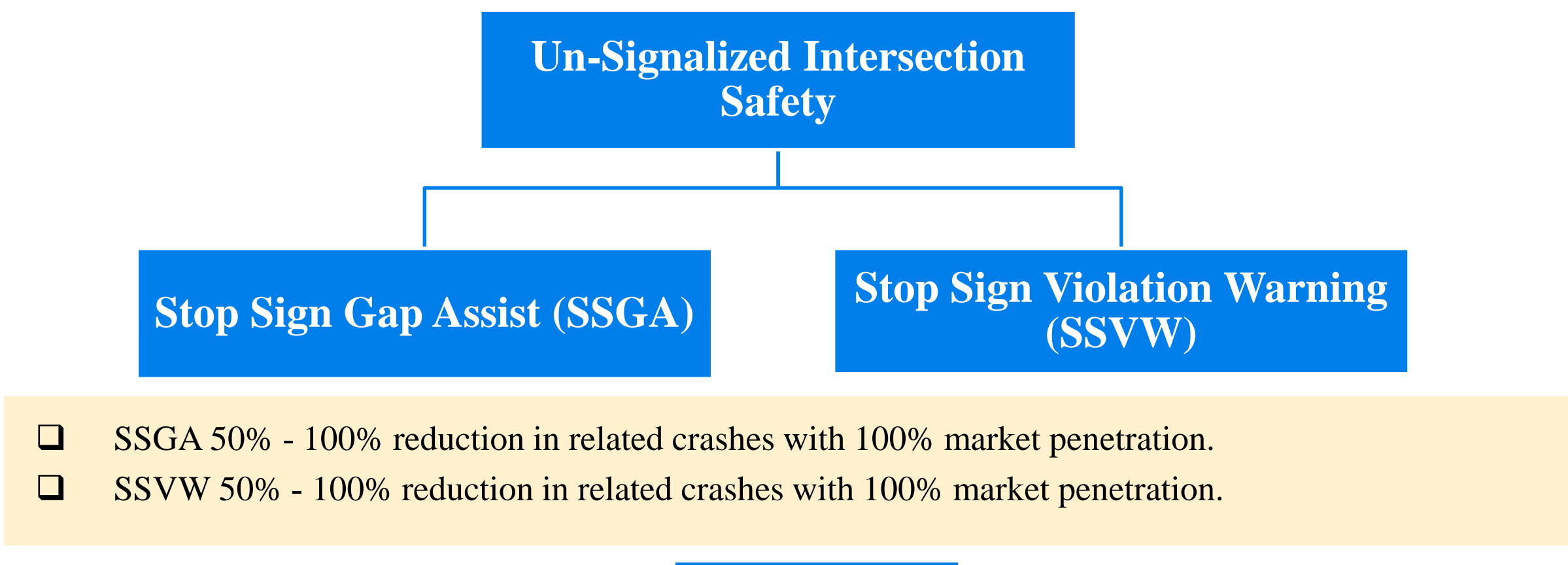
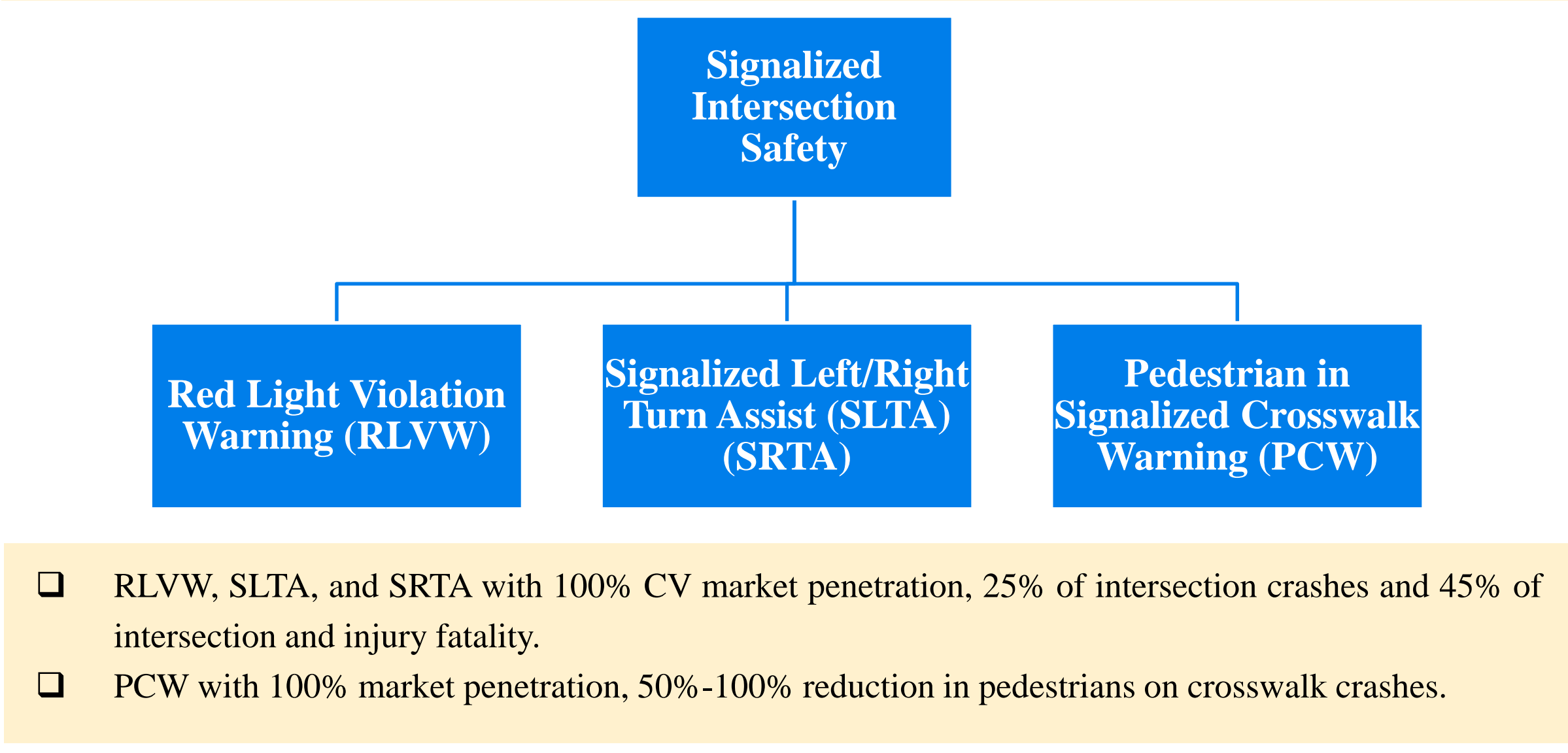
- Connected vehicle technologies start to gain more and more attention from transportation agencies, due to the potential safety benefits provided with these new technologies.
- There is a need to support the decisions of FDOT and other transportation agencies in their implementation of Vehicle-to-Infrastructure (V2I) safety applications, to improve safety performance on urban arterials.

## OBJECTIVES

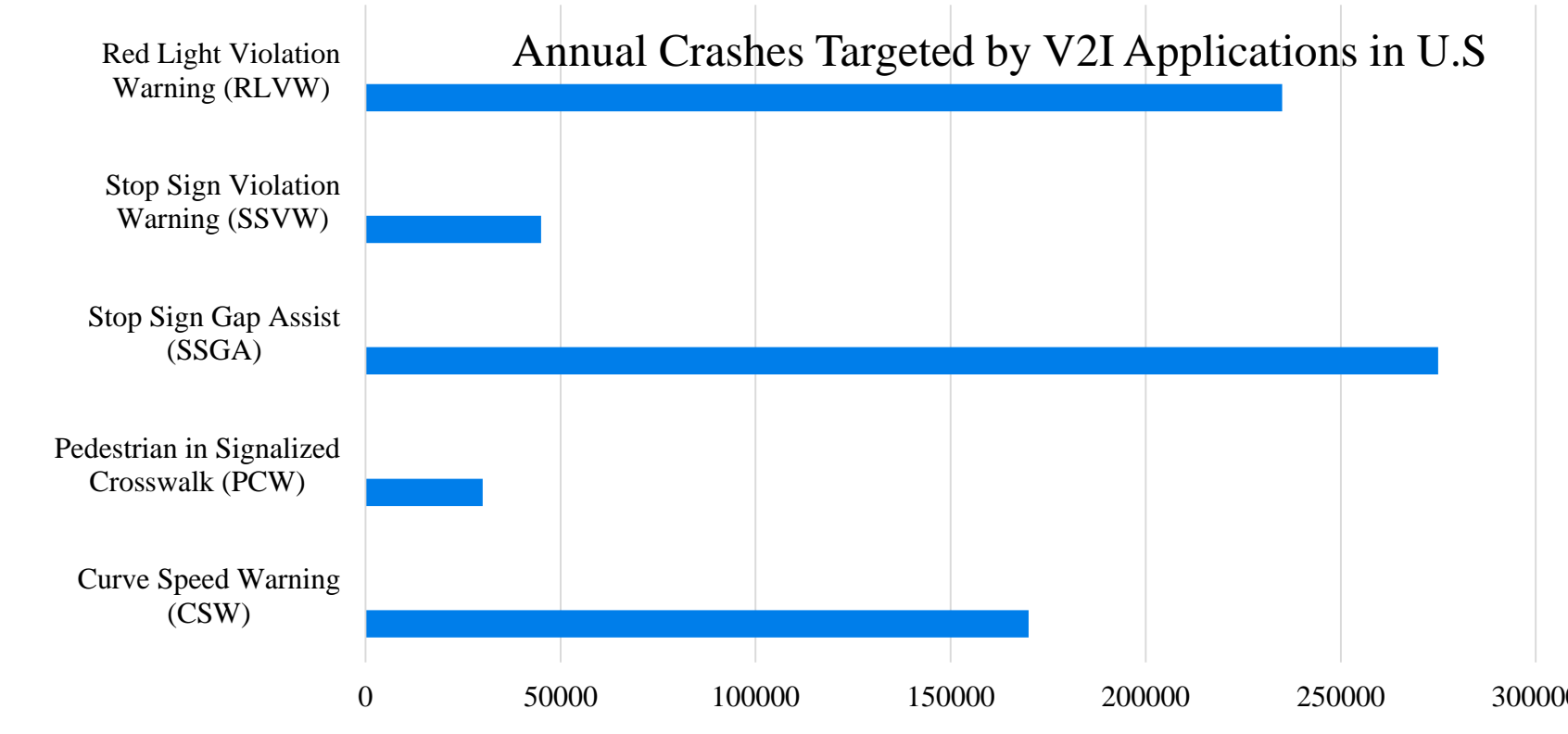
- The objectives of this study is to conduct a return on investment analysis of V2I technologies, in terms of comparing the cost associated with the deployments versus the benefits from crash reductions for a case study corridor (SR 924/NW 119th Street in Miami, FL)

## Proposed Vehicle-to-Infrastructure Safety Applications

- All V2I Crash Modification Factors (CMFs) have been estimated based on the information available in the literature.

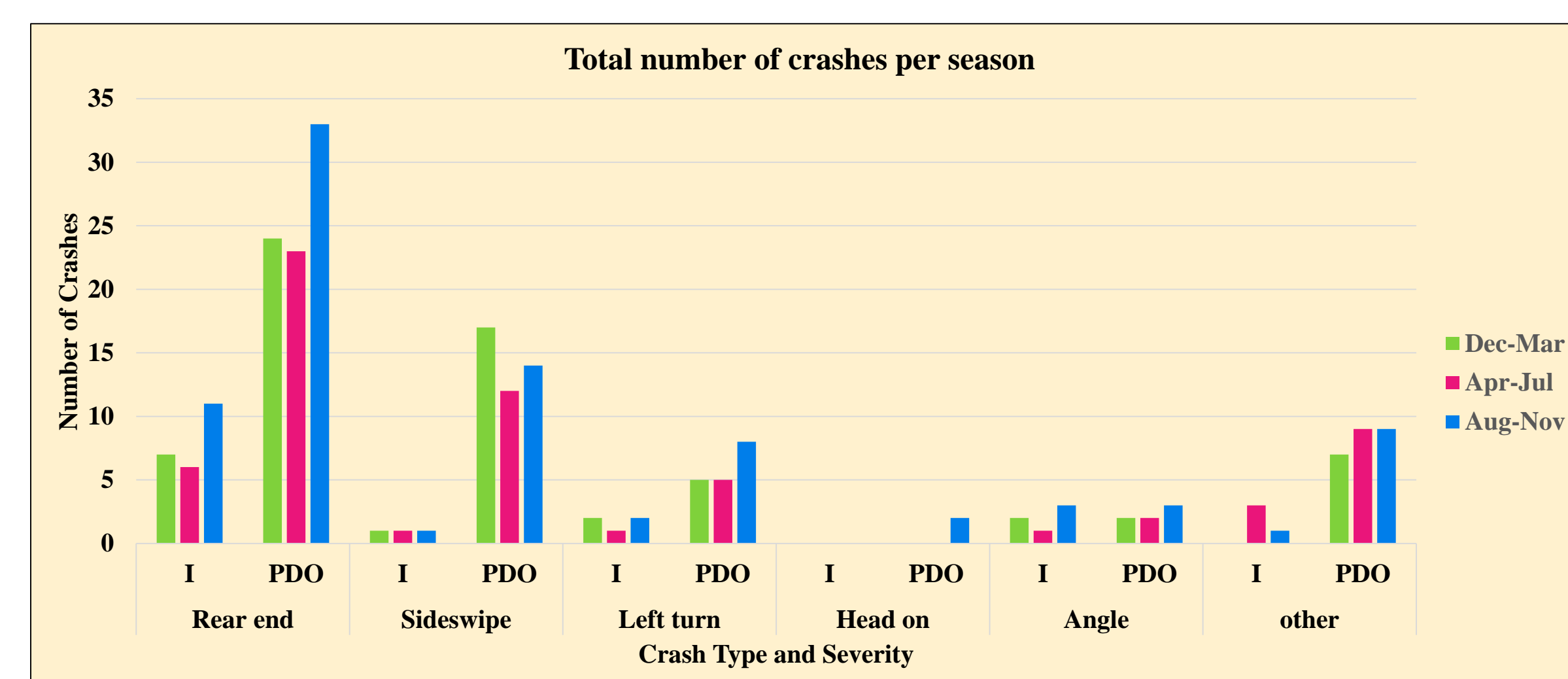
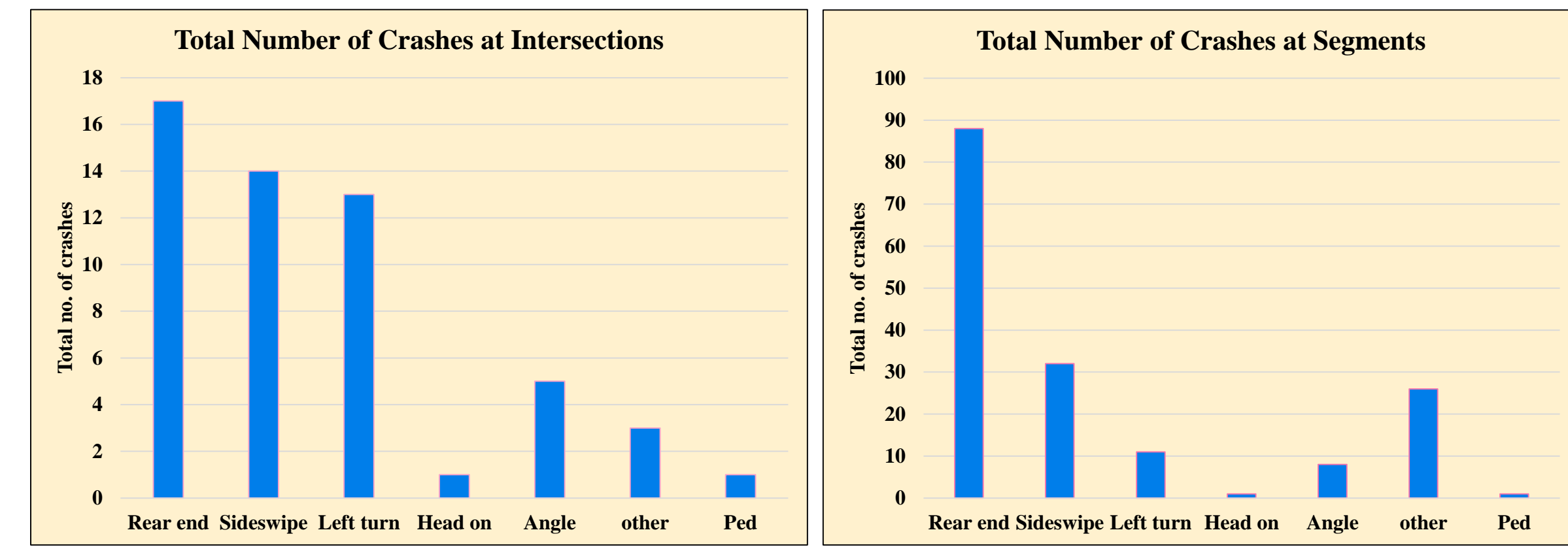
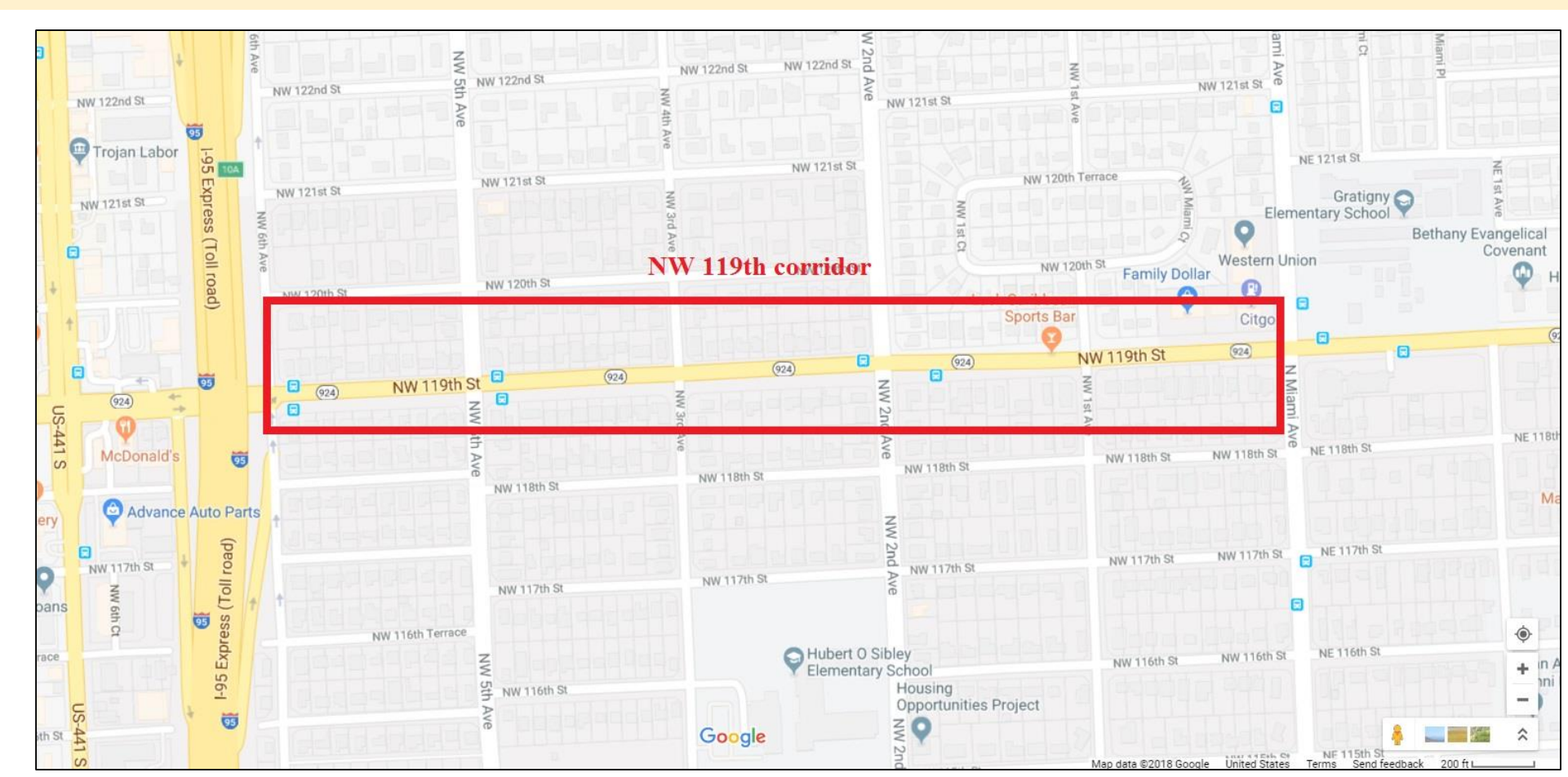


## Vehicle-to-Infrastructure (V2I) Safety Benefits

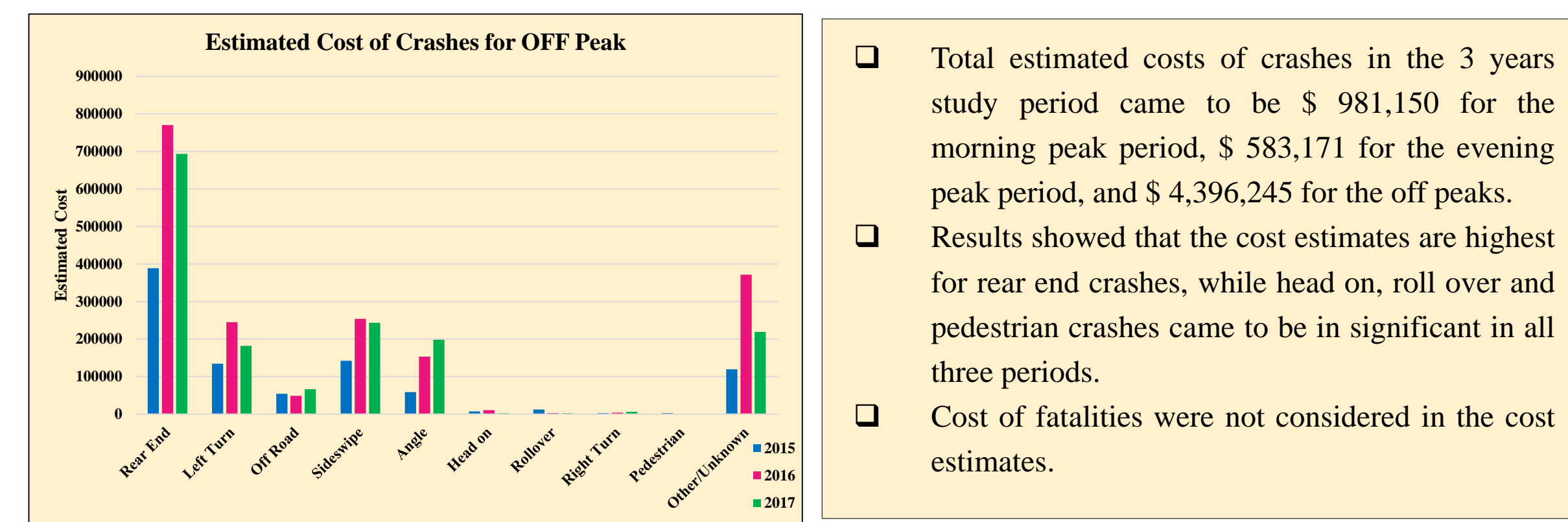
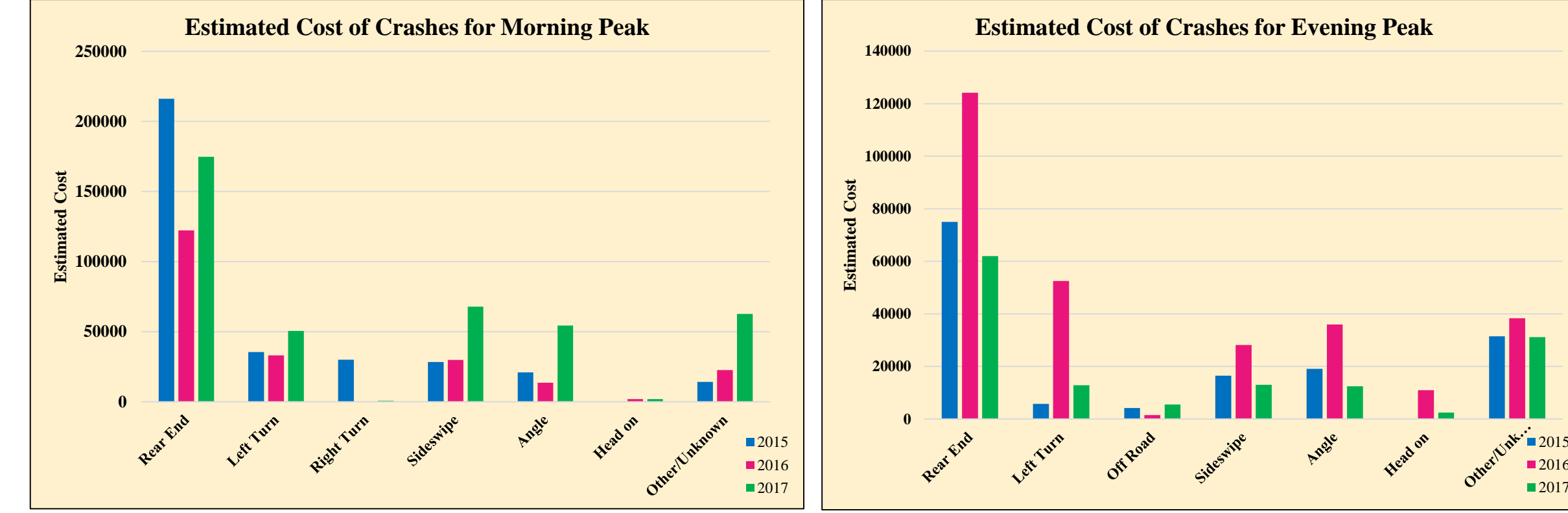


## CRASH DATA for NW 119<sup>th</sup> Street Case Study

- A case study corridor NW 119<sup>th</sup> street, Miami, Florida was selected for collecting the crash data and applying the V2I safety application
- Crash data were collected from "Signal 4 Analytics" a statewide interactive, web-based geospatial crash analytical tool.
- Crashes were identified per type (Rear end, Sideswipe, Left turn, Head on, Angle, Off road, and Roll over) and per severity including (Injuries and Property damage only)
- Crashes were classified per location (Intersections, Segments) for the morning peak from 7:00 am to 9:30 am, evening peak from 4:30 pm to 6:30 pm, and for the off peak period for 3 years from 2015 to 2017. In addition, crashes were classified per season from December to March, April to July, and August to November.



## Estimated Cost of Crashes



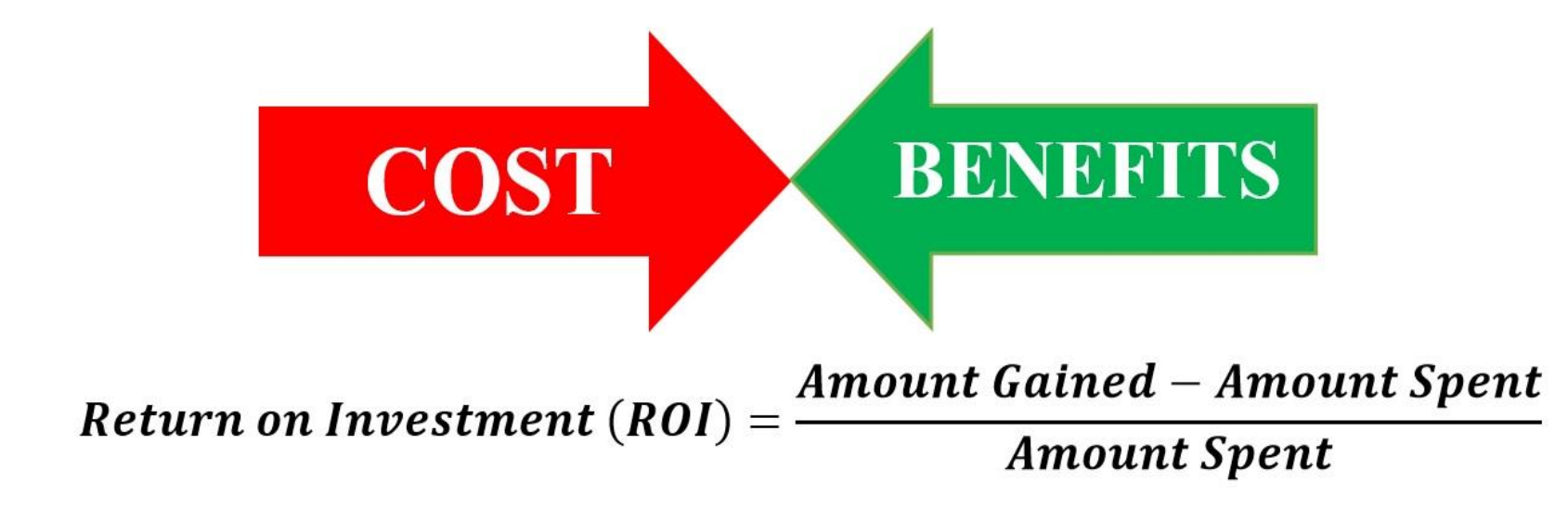
- Total estimated costs of crashes in the 3 year study period came to be \$ 981,150 for the morning peak period, \$ 583,171 for the evening peak period, and \$ 4,396,245 for the off peaks.
- Results showed that the cost estimates are highest for rear end crashes, while head on, roll over and pedestrian crashes came to be in significant in all three periods.
- Cost of fatalities were not considered in the cost estimates.

## Estimated V2I Deployment Cost

- The costs associated with the deployments will be estimated using the AASHTO Life Cycle Cost Model (LCCM). The model provides the Net Present Value (NPV) for each V2I application deployment.

Deployment Components	Estimated Cost
Road Side Equipment	
Curve Speed Warning - DSRC (CSW)	\$78,308
Oversize Vehicle Warning - DSRC (OVW)	\$17,686
Pedestrian in Signalized Crosswalk Warning - DSRC (PSCWT)	\$1,865,779
Data Acquisition System	
Pedestrian Detection System	
Vehicle Detection System	
Driver Infrastructure Interface (DII)	
Driver Vehicle Interface (DVI)	
Railroad Crossing Warning - DSRC (RCW)	\$352,778
Red Light Violation Warning - DSRC (RLVW)	\$225,722
Reduced Speed-Work Zone Warning - DSRC (RSWZW)	\$85,407
Spot Weather Impact Warning - DSRC (SWIW)	\$72,112
Stop Sign Gap Assist - DSRC (SSGA)	\$1,658,733
Stop Sign Violation Warning - DSRC (SSVW)	\$361,901
<b>Total Cost NPV</b>	<b>\$4,718,213</b>

## Return on Investment Conclusions



- A return on investment analysis was conducted assuming 100% market penetration and 100% technology users compliance. The total safety benefits in terms of total crash reduction was converted into dollar value and came to be \$5,960,566. In addition, the total costs associated with the V2I safety applications deployments came to be \$4,718,213. These inputs were used to determine the return on investment of the V2I safety applications for the case study corridor (SR 924/NW 119th Street in Miami, FL).
- The Return on Investment (ROI) value came to be 26.3% without considering the other mobility benefits associated with the deployment.
- Future Research will be conducted to determine the mobility benefits from the V2I application deployment and it's return on investment.