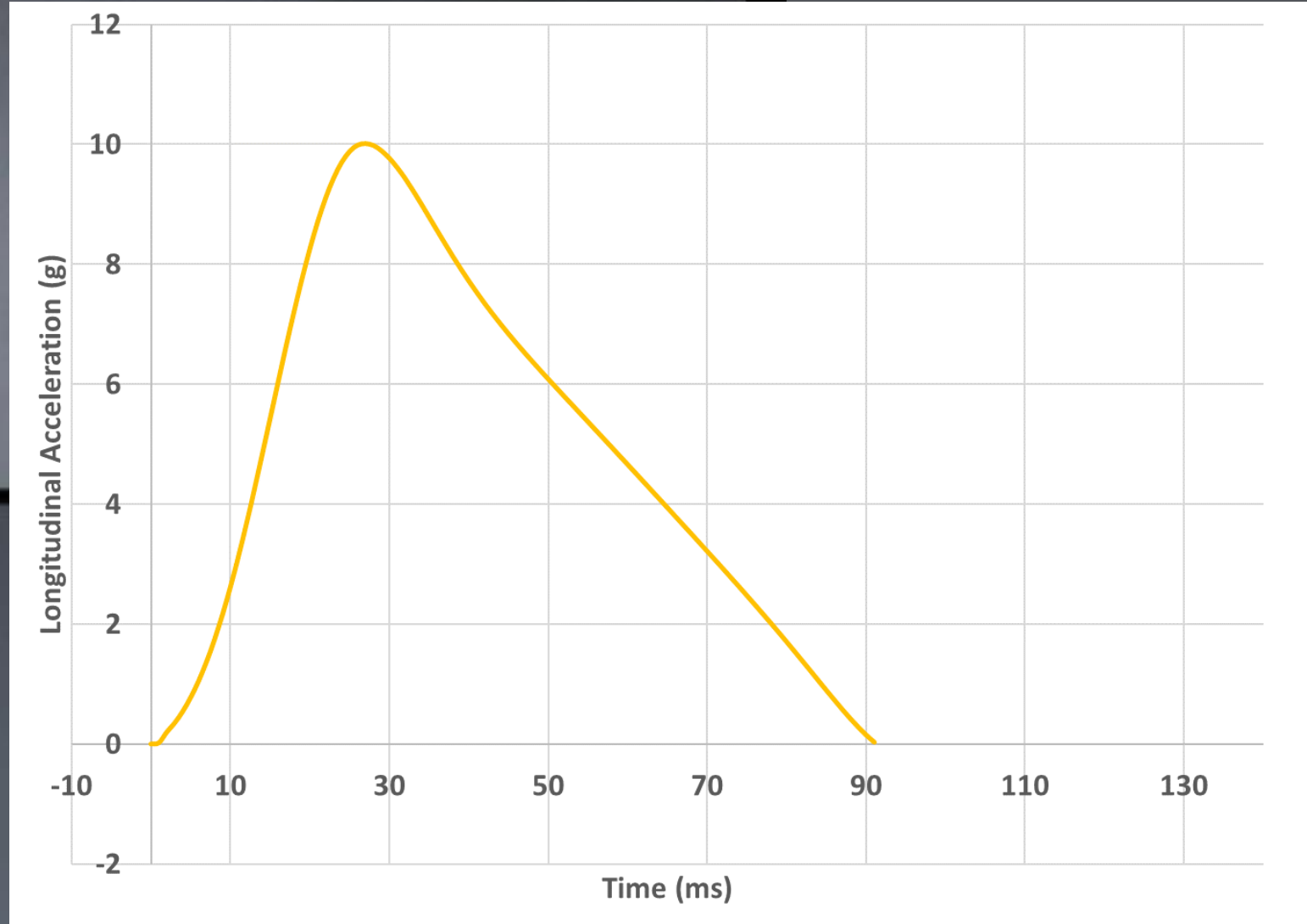
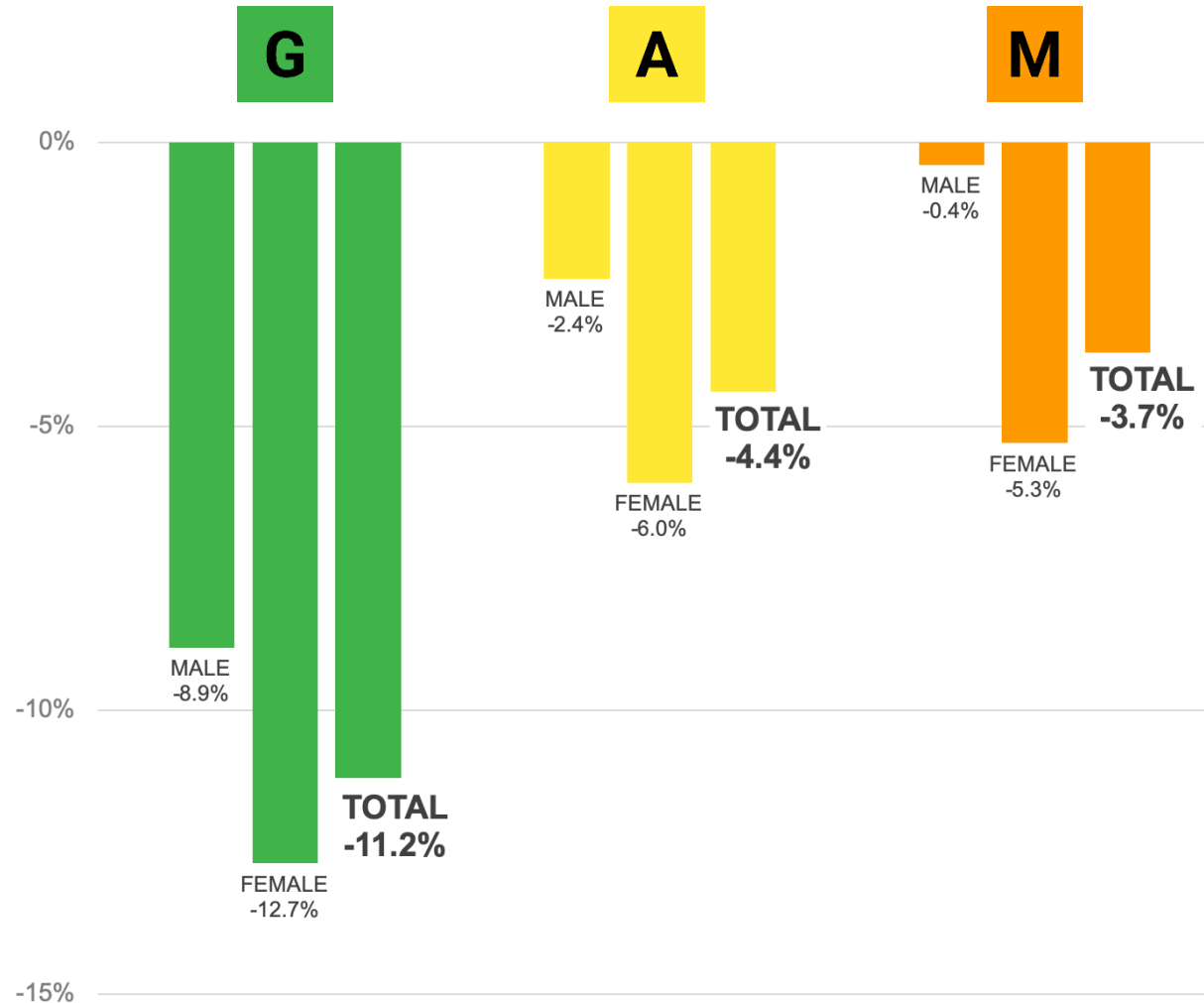


IIHS whiplash evaluation 2004-2022



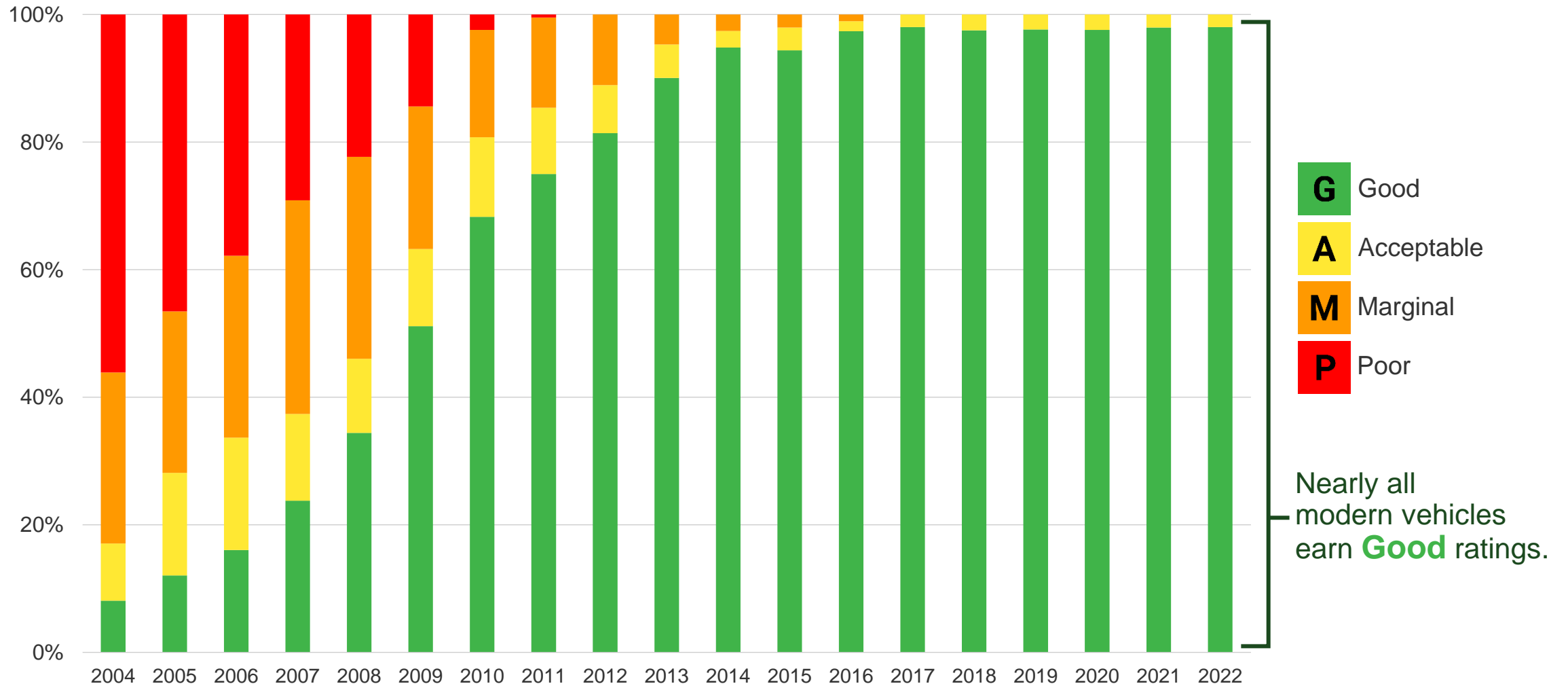
IHS whiplash evaluation

Percent reduction in injury claim rates vs. poor-rated seats



Head restraint ratings by model year

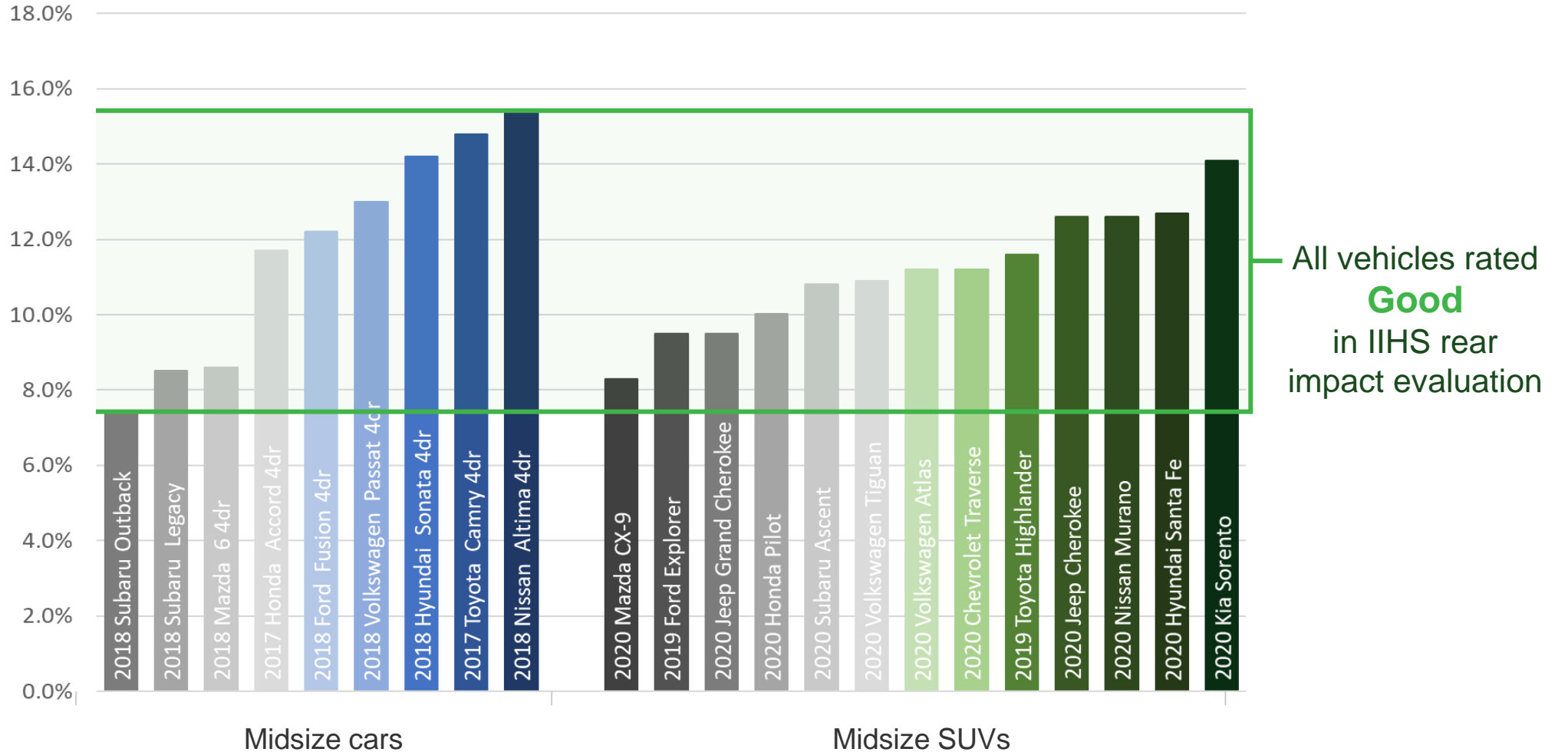
As of August 15, 2022



Nearly all modern vehicles earn **Good** ratings.

Current IIHS ratings vs. real-world data

Insurance injury claim rates (PIP/PDL by class and vehicle)



Continue to reduce whiplash injury in low-severity rear impacts

Active safety technology

Automatic emergency braking

Integrated safety

Pre-impact interventions for rear impacts

Robust seat and restraint design that protect many occupants

Different crash severities

Varied occupant positions

Range of occupant sizes and sex

Continue to reduce whiplash injury in low-severity rear impacts

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Varied occupant positions

Range of occupant sizes and sex

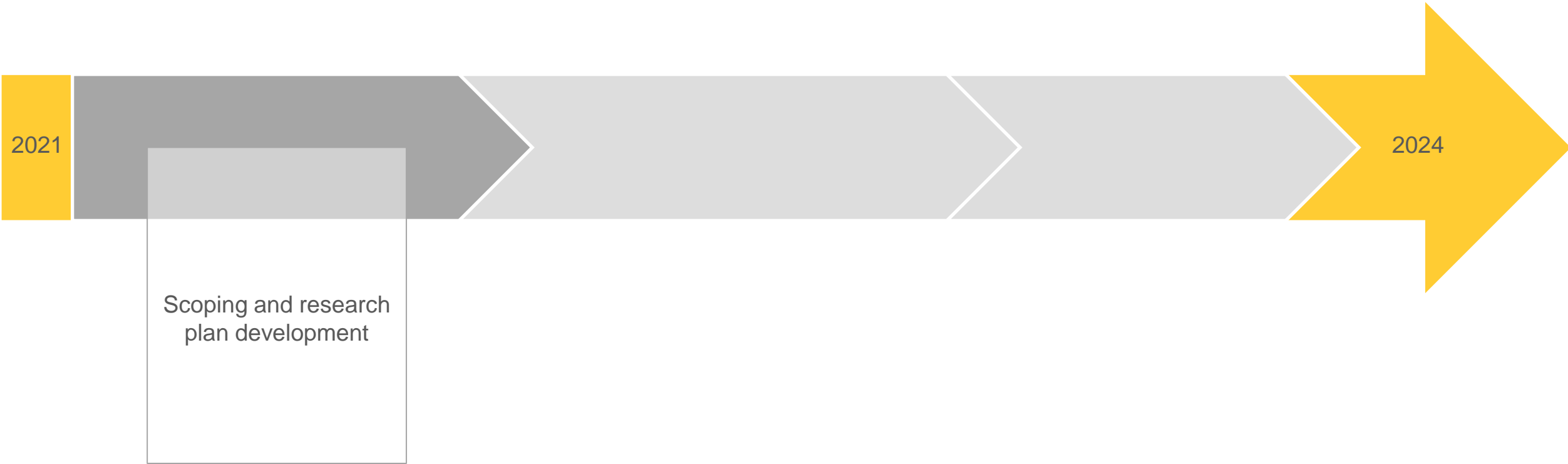
Virtual testing



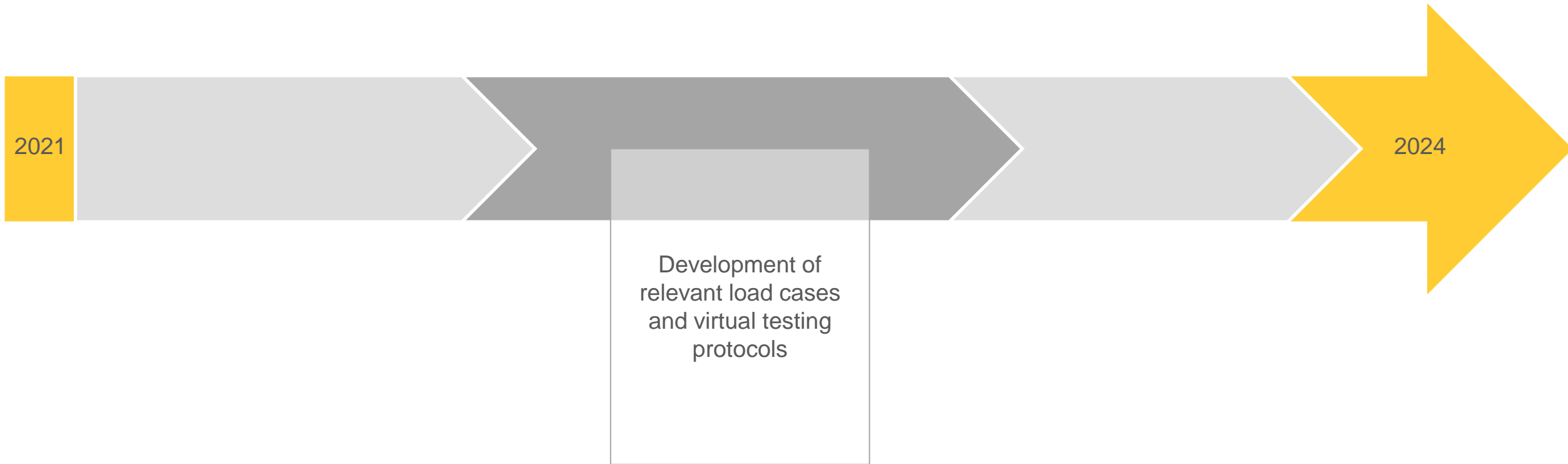
Research motivations

- ▶ Develop a virtual testing framework that can be used to promote seat safety robustness for a range of occupant size, sex, and seating position
- ▶ Lay groundwork for the possible use of human body models to evaluate rear impact whiplash
- ▶ Gain organizational experience with virtual testing and explore opportunities where virtual testing could be feasible and beneficial
- ▶ Develop a framework for the certification and validation of automaker seat models and/or automaker simulation results, data sharing with automakers and a workflow for virtual testing

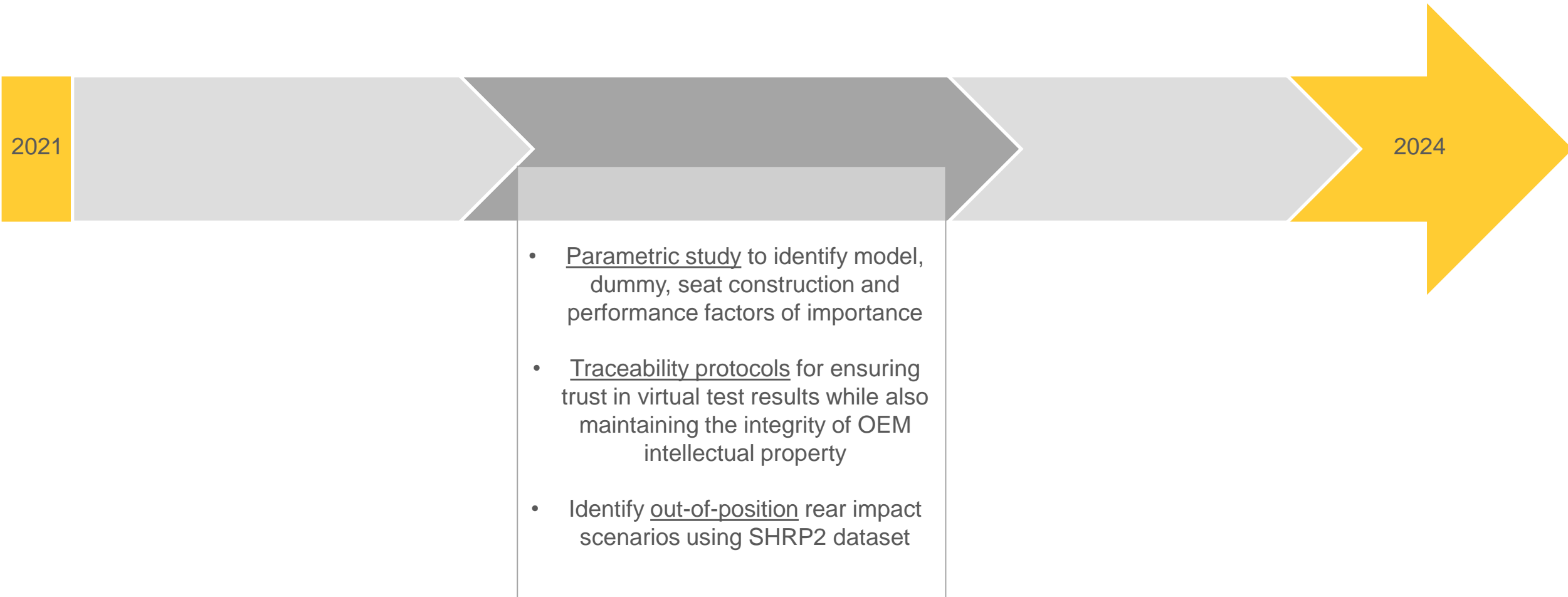
Virtual testing research plan



Virtual testing research plan



Virtual testing research plan

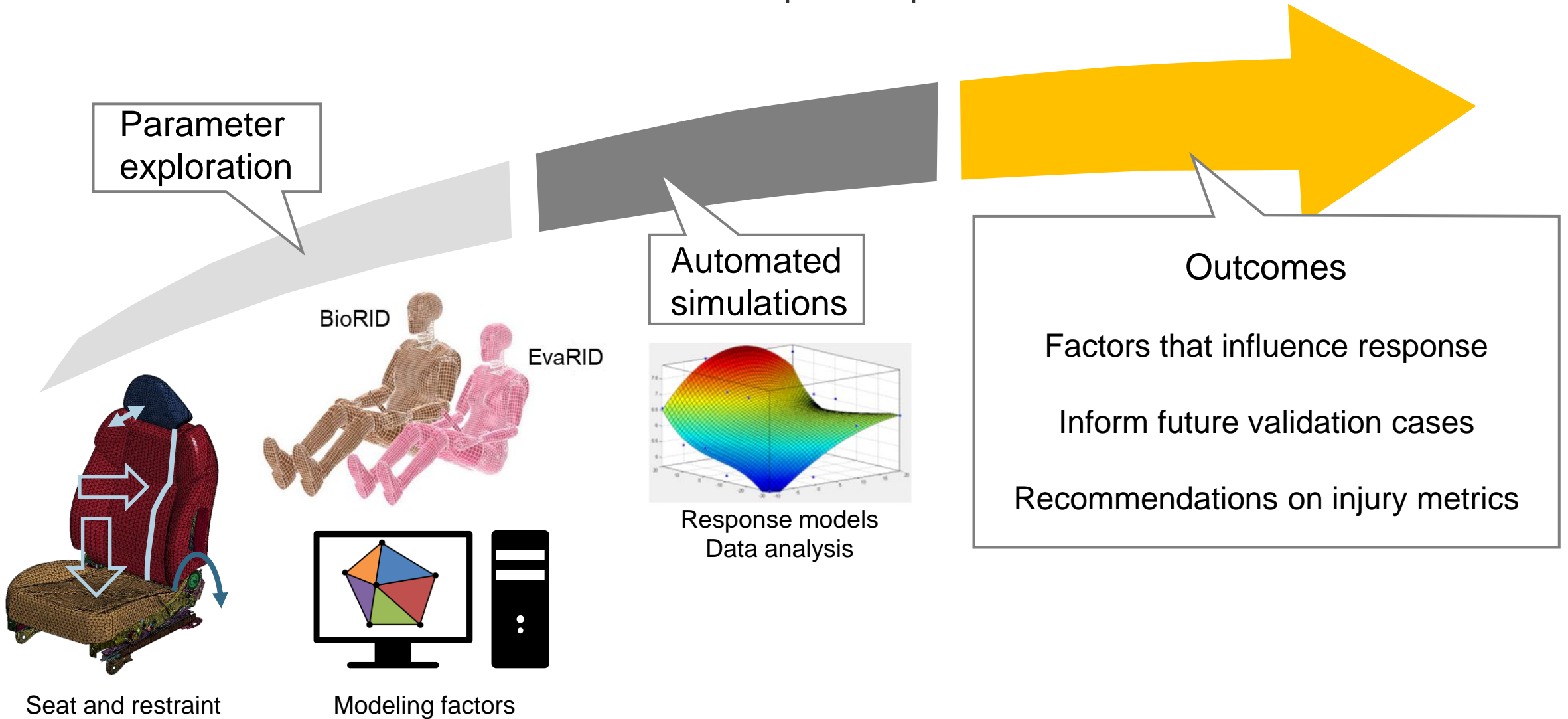


Research Project Updates

- Parameter Study
- Traceability Study
- Out of position scenario study

Parametric study

What affects rear impact responses?



Parameter exploration

Automated simulations

Outcomes

Factors that influence response

Inform future validation cases

Recommendations on injury metrics

BioRID

EvaRID

Response models
Data analysis

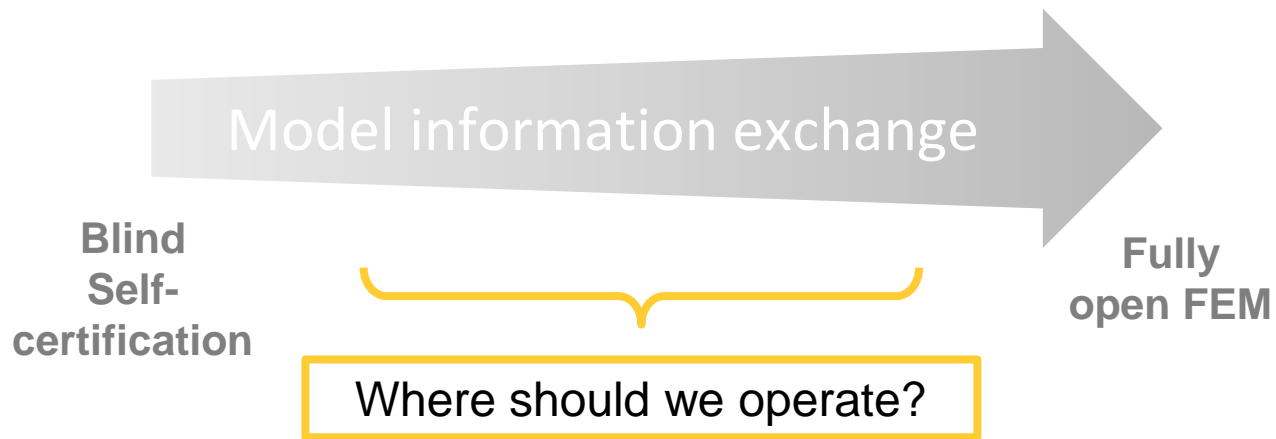
Seat and restraint

Modeling factors

Model traceability

Sharing information without compromising IP concerns

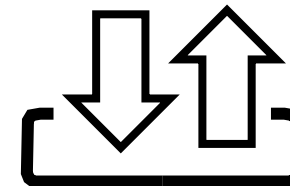
How much information needs to be exchanged?



How do we protect IP concerns?



Fingerprinting



Input-output checker report

Out of position research

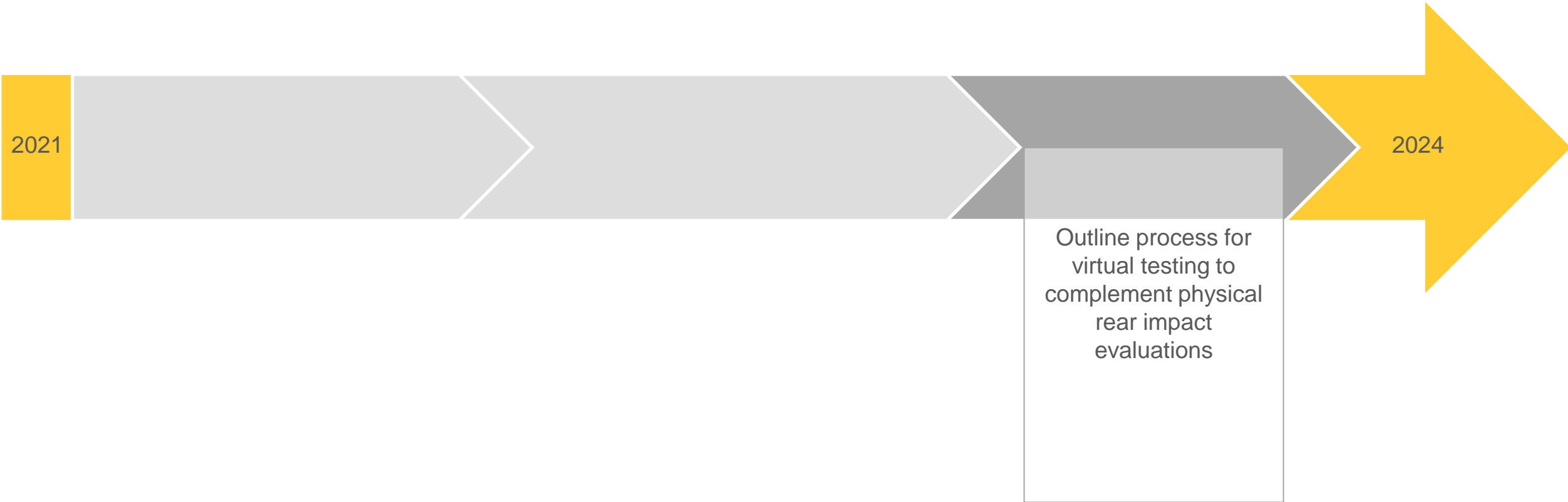
SHRP2 dataset



SHRP2 test sample data - Original and masked video.
Videos must be masked to access outside of secure enclave sites.

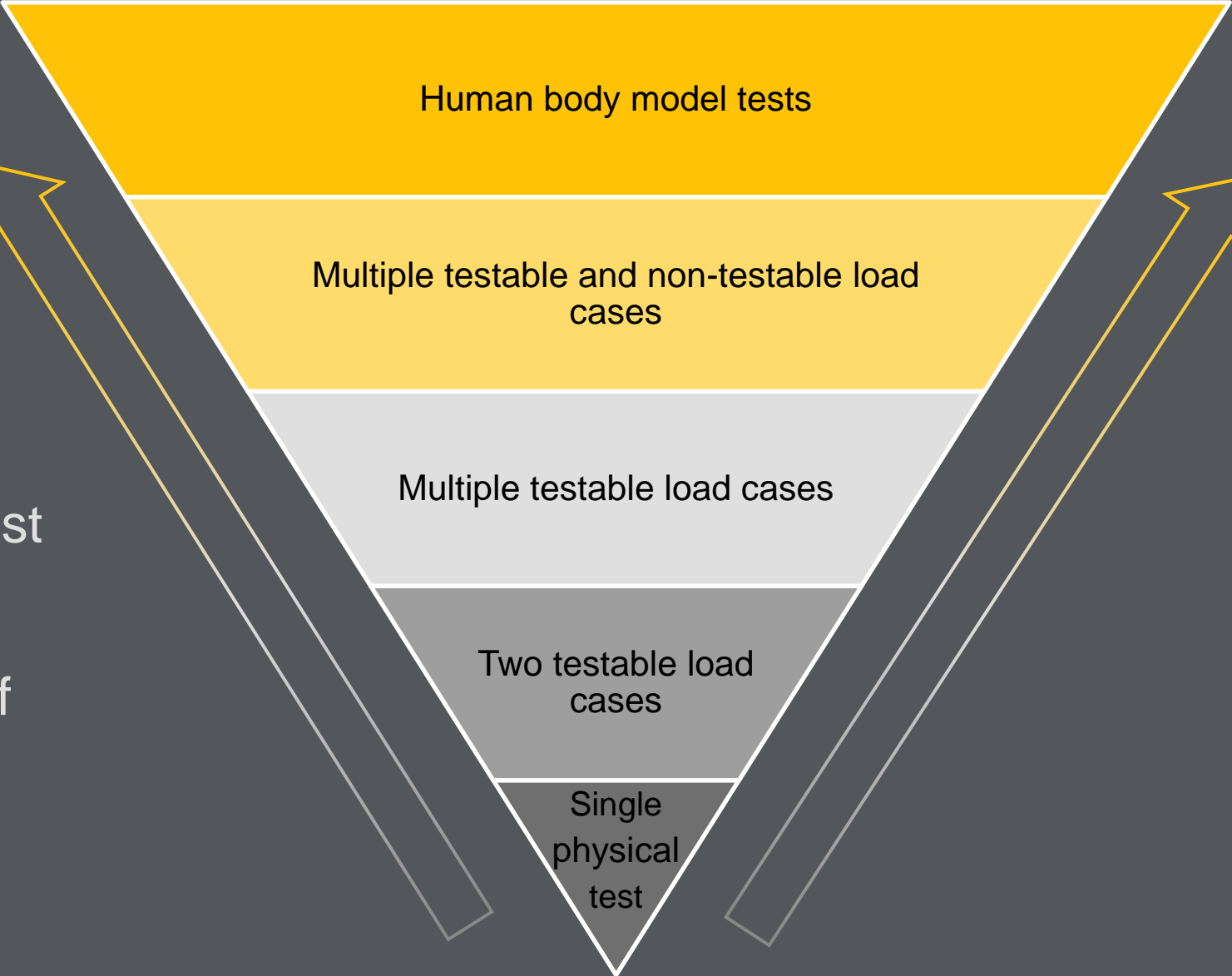
- ▶ Videos will provide high level information on occupant position and actions at the time of a rear impact crash. (e.g., looking left, looking down, head greater than 7 cm from head restraint)
- ▶ Videos will provide information on occupant position at time of crash relative to driver's nominal position

Virtual testing research plan



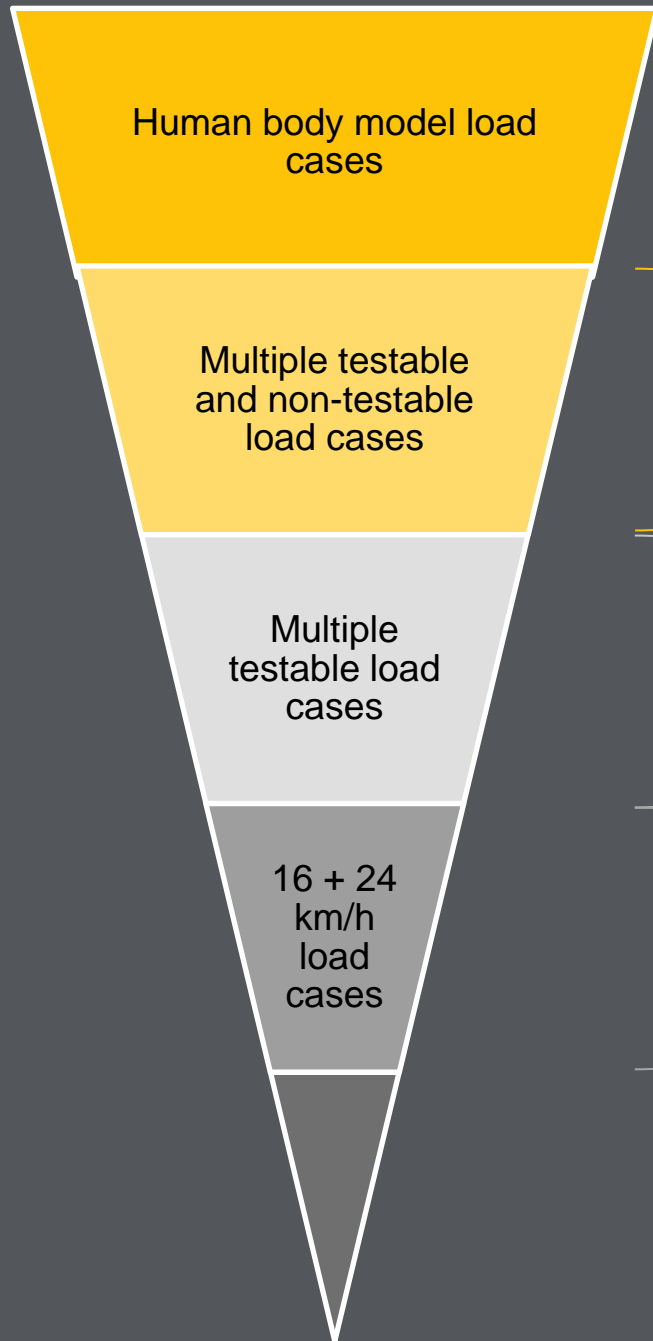
Preliminary Implementation Plan for Virtual Testing for Rear Impacts

Long term virtual testing goal



Expand the variability of test conditions to improve robustness of seat design

Increase complexity of oversight



Use traceability safeguards to allow models validated with a physically testable case to be used for untestable cases

Expand load cases and the tools for assessment without sophisticated oversight

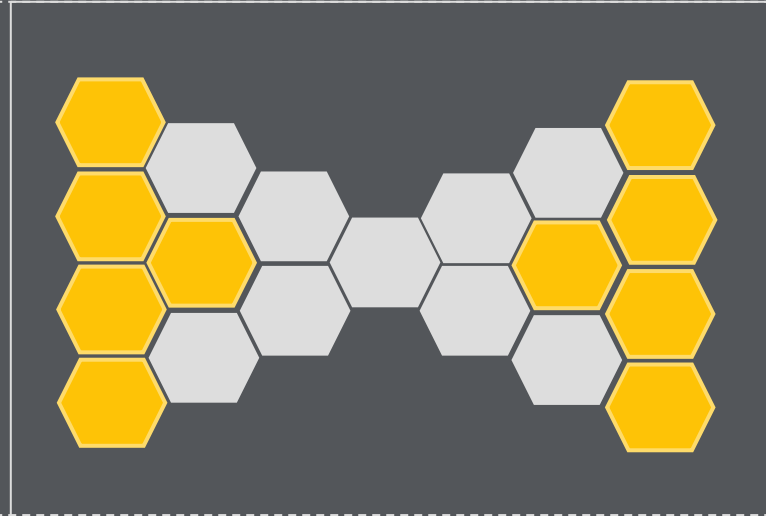
Introduce simulation in evaluation in a way that does not require sophisticated oversight

Virtual testing strategy

Validate many load cases with few physical tests



Physically testable cases



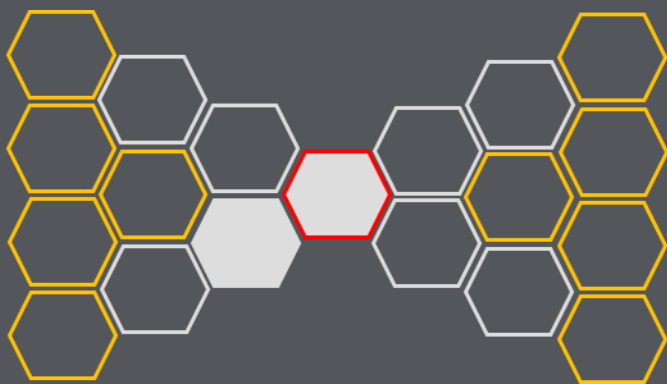
Untestable cases

**IIHS Rear Impact
Concept Assessment
Matrix**



Auditing and validation

1.0 Targeted auditing concept



Assessed load cases

Future load cases

Audited tests

Physically
testable



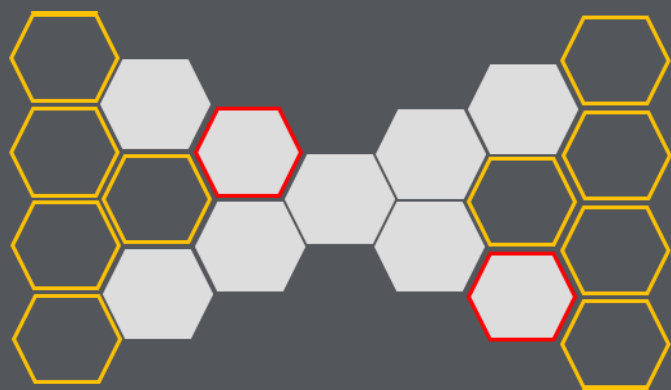
Physically
untestable





Auditing and validation

2.0 Random auditing concept



Assessed load cases

Future load cases

Audited tests

Physically
testable



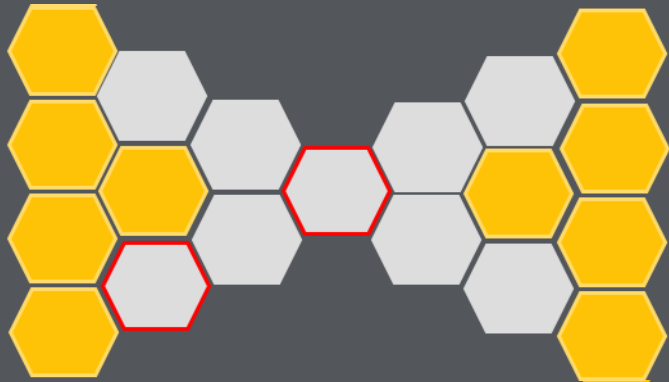
Physically
untestable





Auditing and validation for untestable load cases

3.0 Traceability safeguards concept



Assessed load cases

Future load cases

Audited tests

Physically testable



Physically untestable



Virtual testing workflow

Automaker conducts physical or simulated rear impact tests and provides results to IIHS




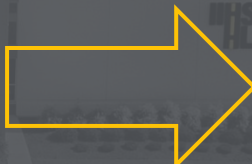

IIHS physically audits select loads cases to validate all results



After comparison analysis and correction rear impact rating is applied



Next steps

- Quantify test variation and simulation error for the acceptance of physical and simulation data from automakers  Collaboration study with automakers to run IIHS/automaker paired tests and simulations
- Finalize protocols for rating 16 km/h and 24 km/h rear impact tests  Run pilot series of small SUV seats to make final decisions on rating metrics and boundaries
- Develop protocols for the acceptance of physical and simulation data  Based on experience from collaboration study and input from industry experts outline the input requirements for tests/simulations and reporting guidelines and templates

Rear Impact research and evaluations

September
2024

September
2025

February
2026

Finalize protocols

- Testing variation
- Simulation error
- Protocols for testing and assessment of 16 km/h and 24 km/h pulses
- Protocols for acceptance of verification submission (physical or simulation)

Initiate evaluation program

- Request verification data (physical or simulation) for 16 km/h and 24 km/h tests
- Conduct 1 physical audit/validation test in-house

Update rear impact ratings

- Targeting 2026 TSP

Expand evaluations

- Occupant size
- Seating positions
- Development of software and/or hardware tools needed to move beyond BioRID in standard seating position

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Highway Loss Data Institute

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THANK YOU



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