
Driven Forward
The Future of Mobility
MOHAMMAD BOKHARI

YOUR 52-PAGE VISUAL ROUTE

Inside This Visual Atlas

01 The first automobiles
EXPLORE →

02 How vehicles move
EXPLORE →

03 Safety systems
EXPLORE →

04 Electric mobility
EXPLORE →

05 Cost and ownership
EXPLORE →

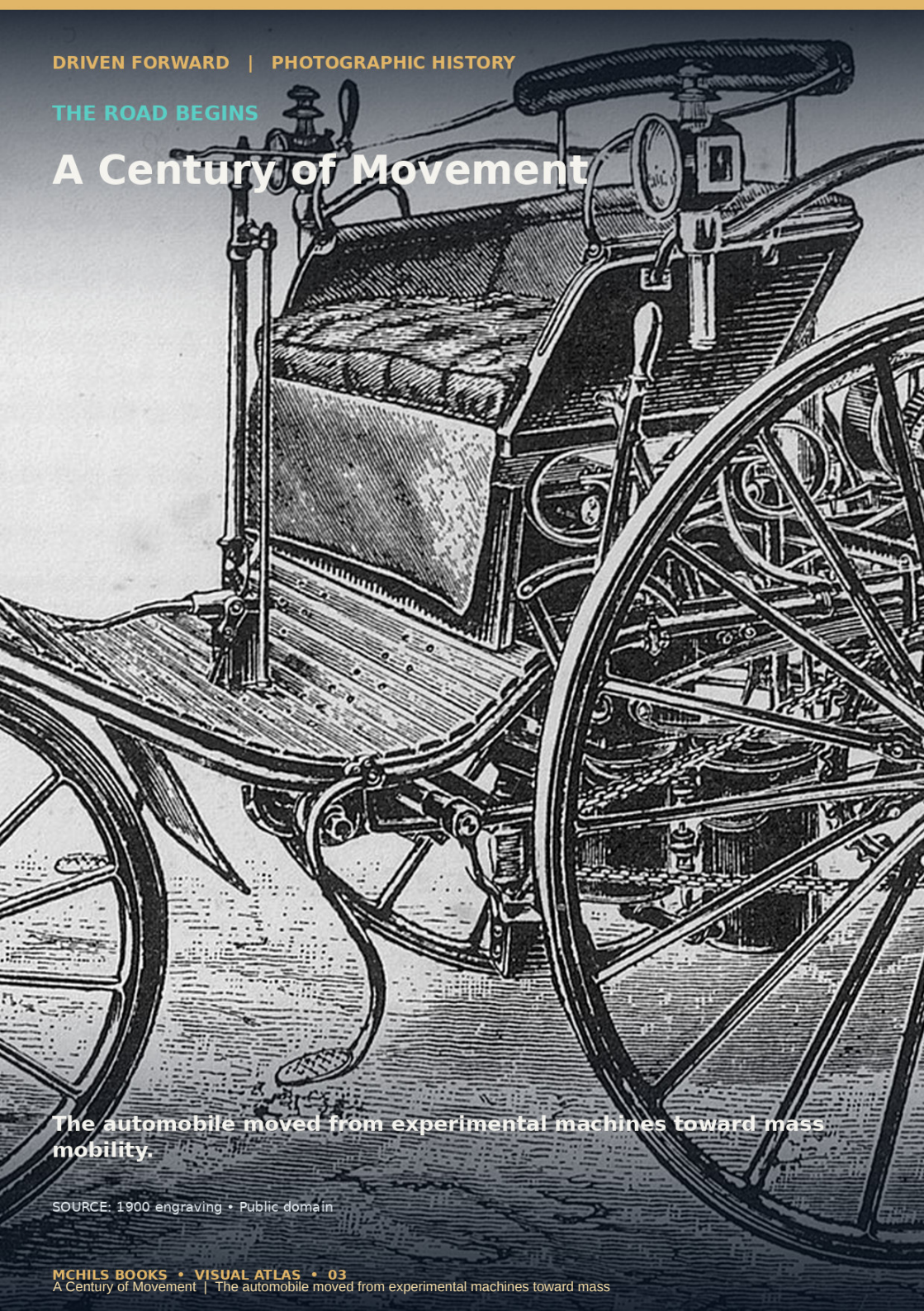
06 Tomorrow’s cities
EXPLORE →

Every page contains a photograph, diagram, pictorial comparison, or illustrated guide.

Inside This Visual Atlas | Every page contains a photograph, diagram, pictorial compari

THE ROAD BEGINS

A Century of Movement



The automobile moved from experimental machines toward mass mobility.

SOURCE: 1900 engraving • Public domain

1908 MODEL T TOWN CAR

An Early Ford Town Car

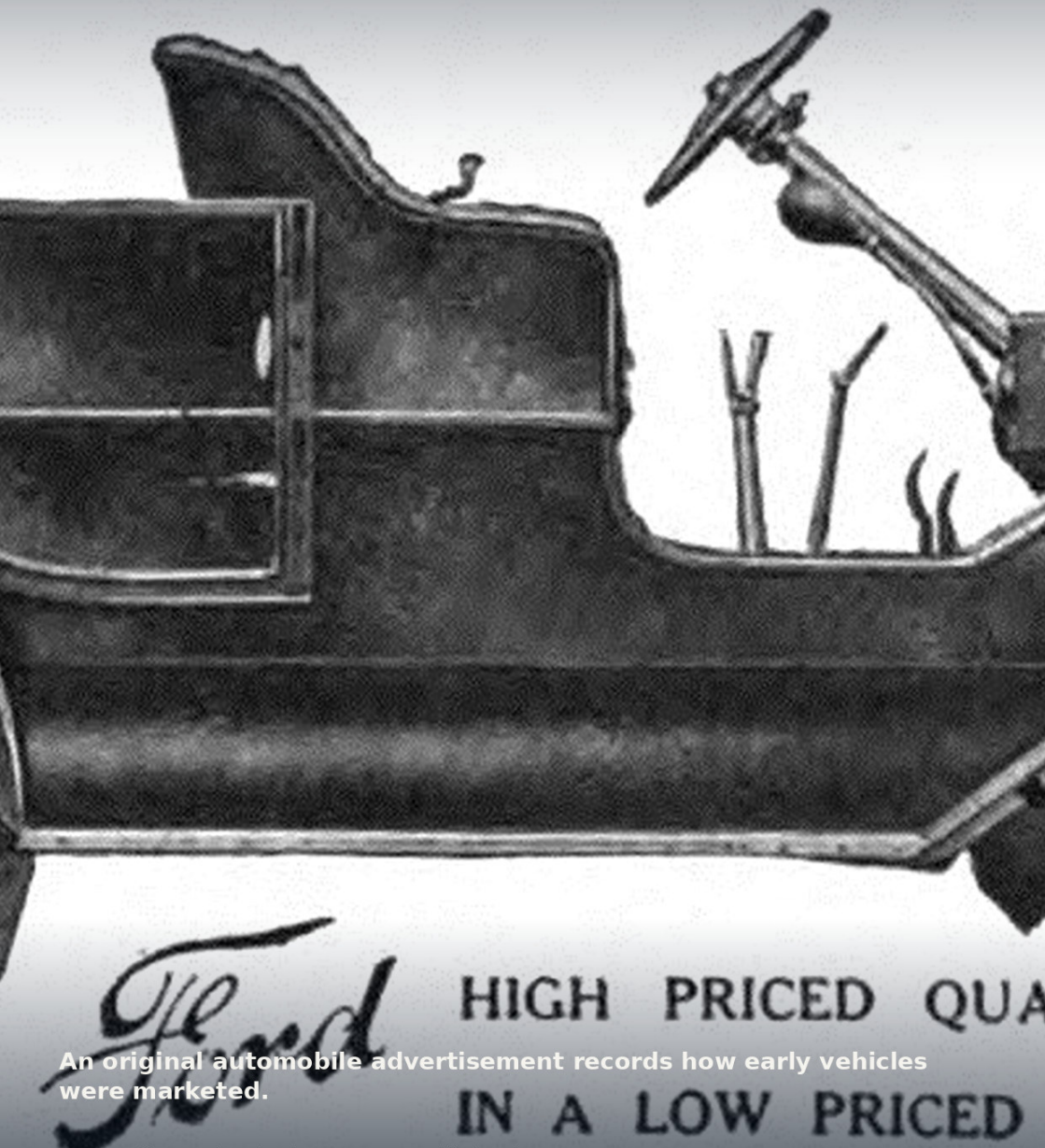


A museum photograph shows the proportions and detailing of an early touring-era automobile.

SOURCE: Ford Model T Town Car • Alf van Beem, CC0

1908 ADVERTISING ARCHIVE

The Model T Era

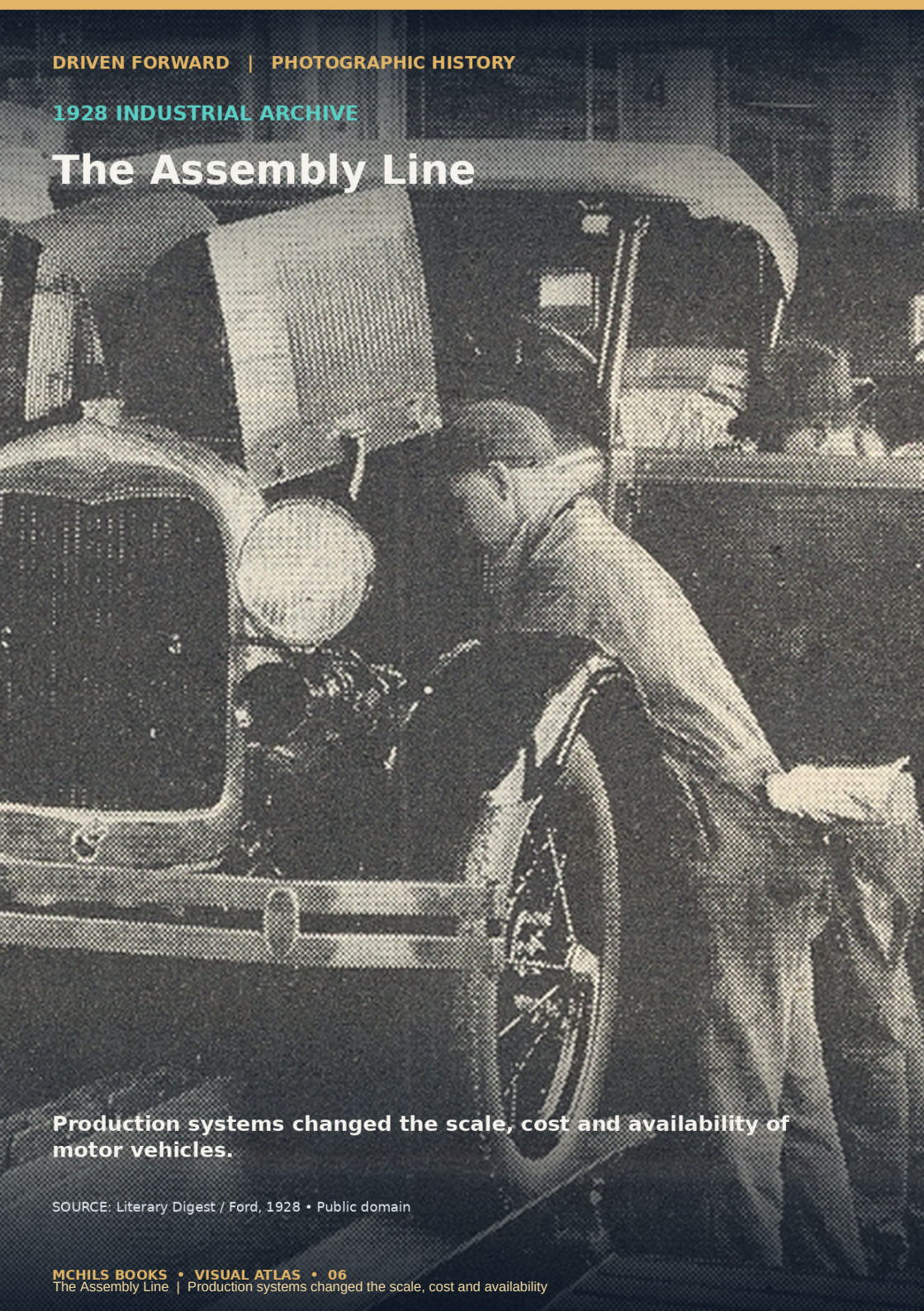


An original automobile advertisement records how early vehicles were marketed.

SOURCE: Life magazine advertisement, 1908 • Public domain

1928 INDUSTRIAL ARCHIVE

The Assembly Line



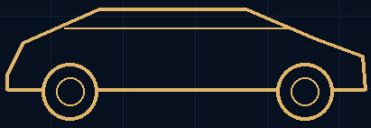
Production systems changed the scale, cost and availability of motor vehicles.

SOURCE: Literary Digest / Ford, 1928 • Public domain

1886 → CONTEMPORARY MOBILITY

An Evolution of Ideas

- 1886 • practical motor car
- 1908 • Model T enters production
- 1920s • industrial-scale assembly
- Mid-century • wider vehicle adoption
- Late 20th c. • electronic controls
- Today • EVs and safety sensors



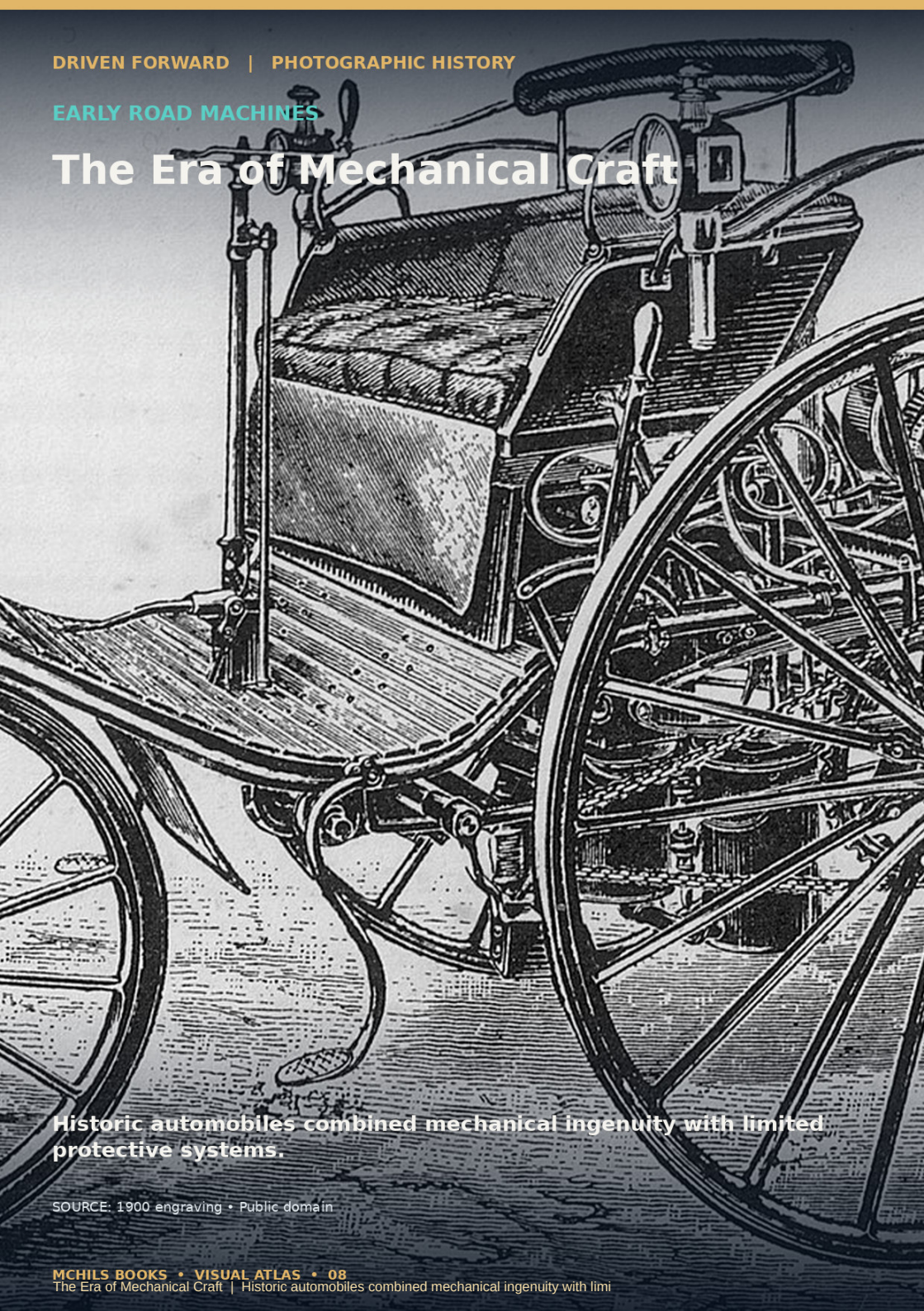
A visual sequence of technological change, not a claim that progress was uniform.

An Evolution of Ideas | A visual sequence of technological change, not a claim that

DRIVEN FORWARD | PHOTOGRAPHIC HISTORY

EARLY ROAD MACHINES

The Era of Mechanical Craft



Historic automobiles combined mechanical ingenuity with limited protective systems.

SOURCE: 1900 engraving • Public domain

A REAL ENGINE COMPARTMENT

Under the Hood



Mechanical components and service access determine reliability and repairability.

SOURCE: ZAZ-965 engine bay • DL24, CC0

POWERTRAIN FLOW

Where Energy Travels

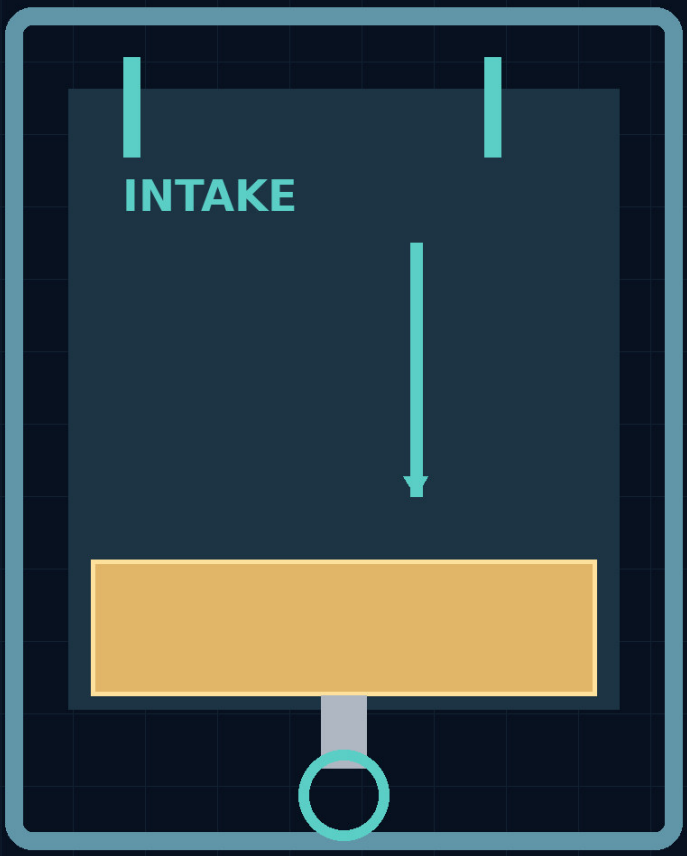


Fuel or electricity must pass through a series of components before reaching the road.

Where Energy Travels | Fuel or electricity must pass through a series of components

FOUR-STROKE ENGINE ILLUSTRATED

The Intake Stroke



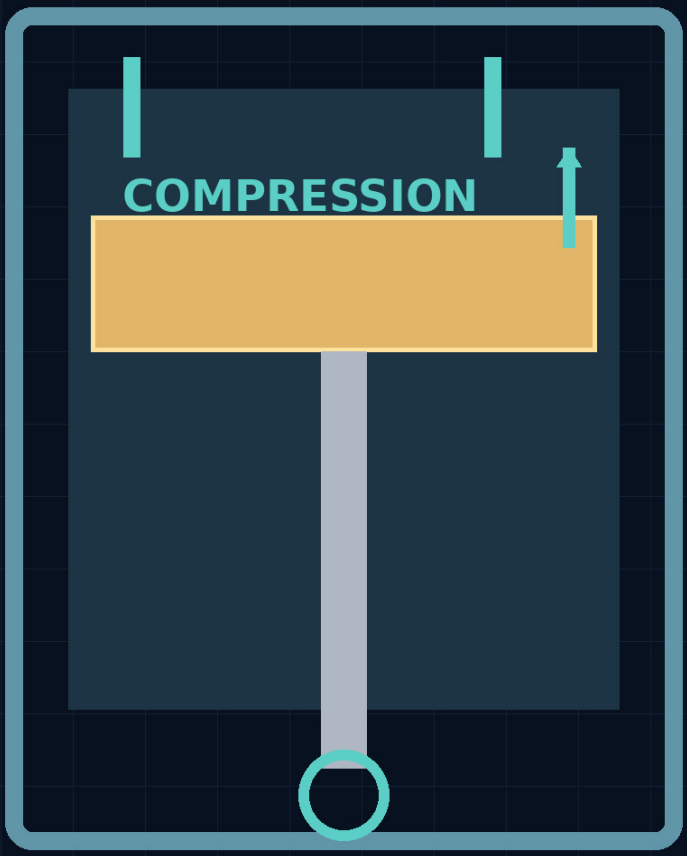
Piston moves down

Intake valve opens

Fresh charge

FOUR-STROKE ENGINE ILLUSTRATED

The Compression Stroke



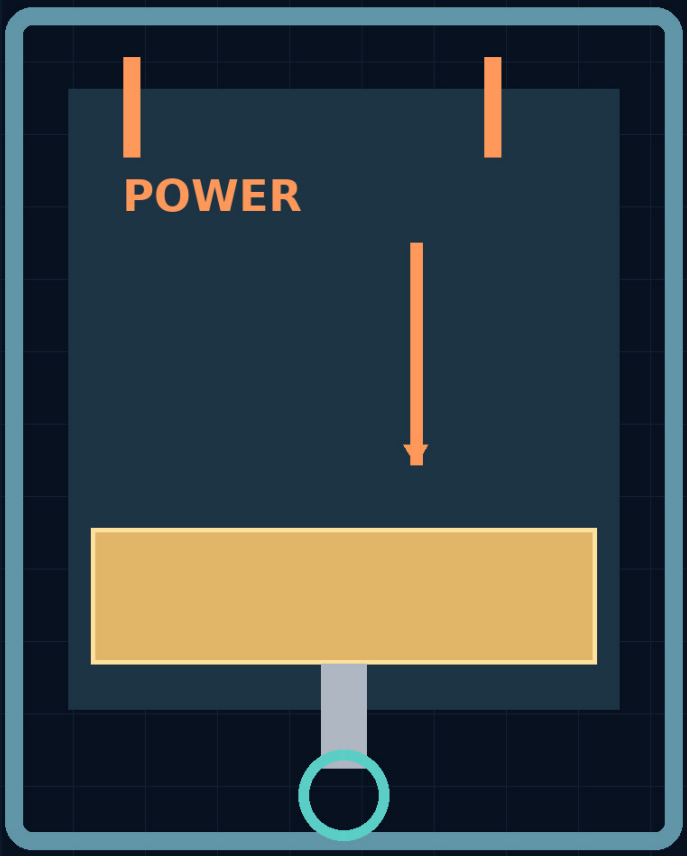
Piston moves up

Valves remain closed

Charge is compressed

FOUR-STROKE ENGINE ILLUSTRATED

The Power Stroke



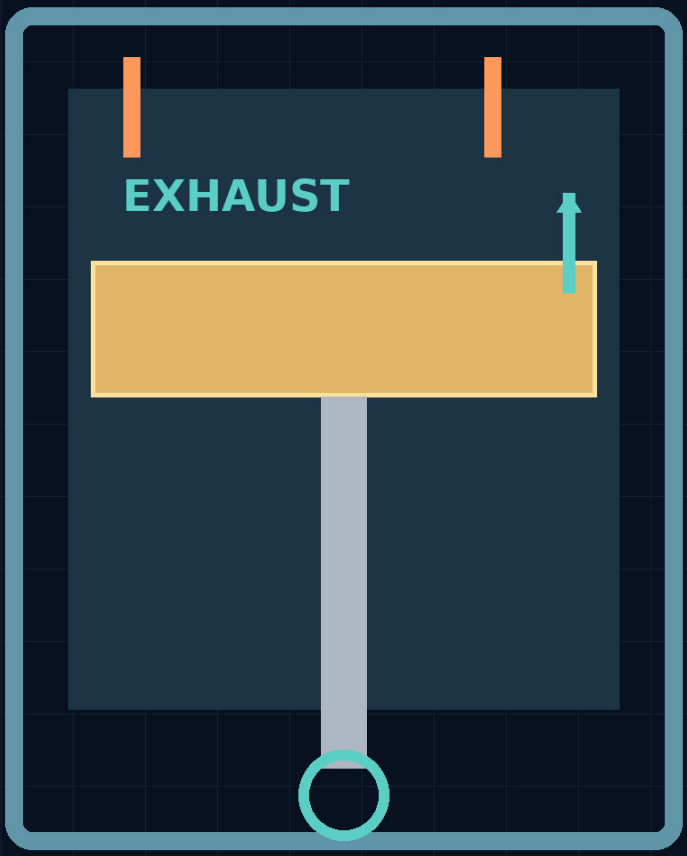
Pressure pushes down

Crankshaft turns

Combustion drives motion

FOUR-STROKE ENGINE ILLUSTRATED

The Exhaust Stroke



Piston rises

Exhaust valve opens

Spent gases leave

TRANSMISSION OVERVIEW

How Power Reaches the Wheels

1. Engine or electric motor
2. Ratio selection
3. Differential
4. Driven axle
5. Wheels and road

Different gears balance wheel force and rotational speed.

How Power Reaches the Wheels | Different gears balance wheel force and rotational speed.

DRIVETRAIN CHOICES

Front, Rear or All-Wheel Drive

01



FWD • front-wheel drive

02



RWD • rear-wheel drive

03

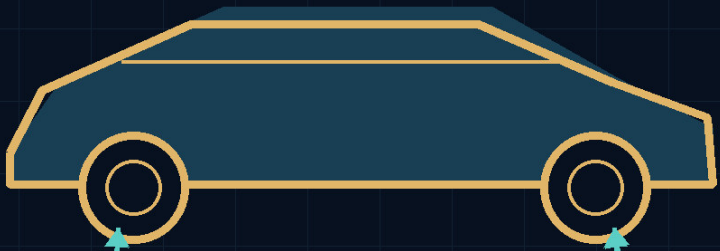


AWD • multiple driven axles

Layout affects packaging, traction characteristics and mechanical complexity.

VEHICLE CONTROL

Steering, Step by Step



1. Steering wheel
2. Steering rack
3. Tie rods
4. Front-wheel angle

Driver input changes the direction of the road wheels through steering linkages.

Steering, Step by Step | Driver input changes the direction of the road wheels throug

SPRINGS AND DAMPERS

Suspension Makes Contact



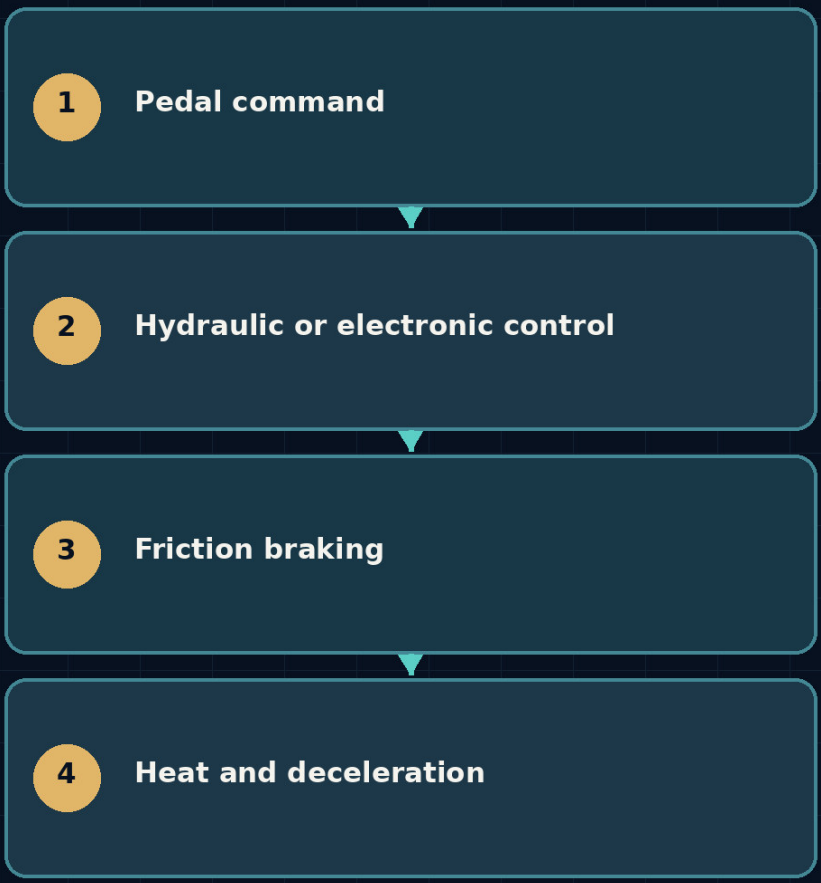
1. Spring supports weight
2. Damper controls motion
3. Control arm guides wheel
4. Tire maintains contact

Good suspension controls wheel motion while supporting comfort and road holding.

Suspension Makes Contact | Good suspension controls wheel motion while supporting comfo

DISC AND FRICTION

Braking Converts Motion

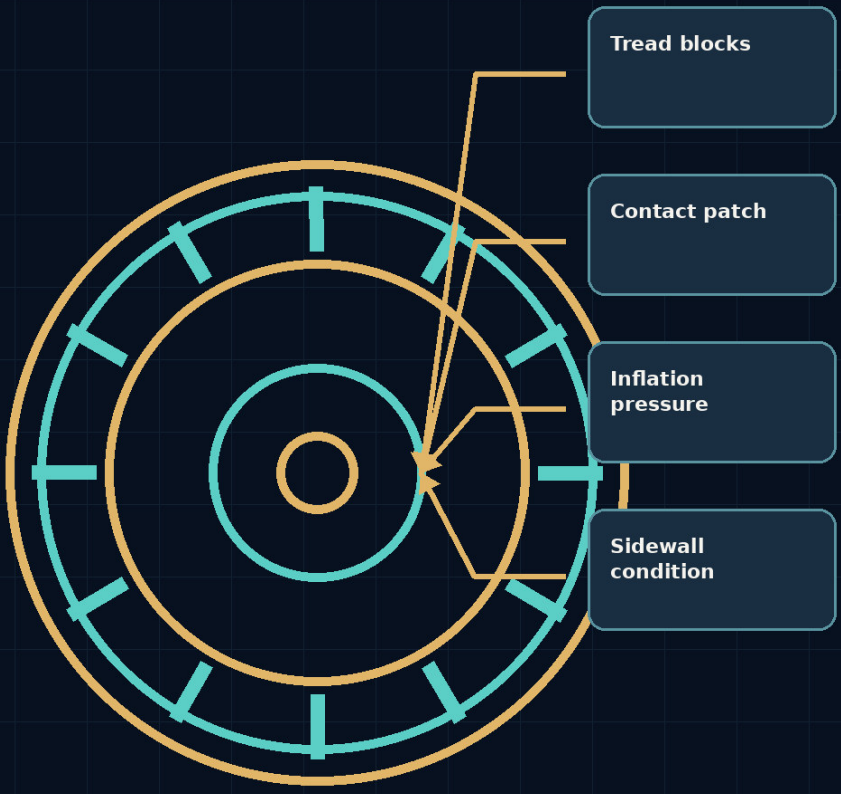


Brakes slow wheel rotation by converting kinetic energy to heat.

Braking Converts Motion | Brakes slow wheel rotation by converting kinetic energy to h

TREAD, GRIP AND WEAR

The Tire Tells the Story



Tire condition, correct pressure and suitable tread matter as much as wheel size.

The Tire Tells the Story | Tire condition, correct pressure and suitable tread matter a

WET-WEATHER TRACTION

Why Tires Matter

01



Dry road: better potential grip

02



Wet road: reduced grip

03



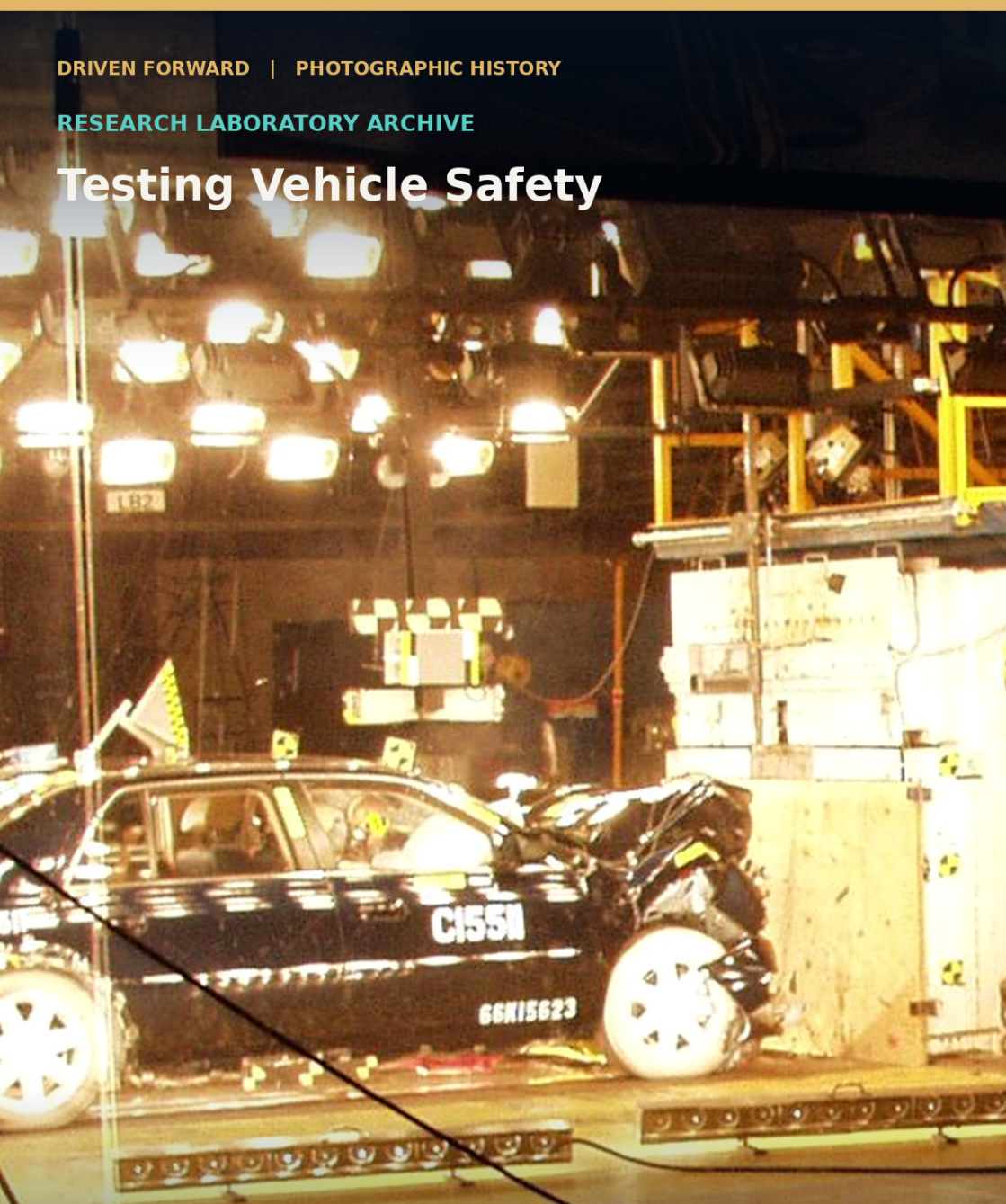
Worn tire: greater risk

Safe stopping depends on road, tire, speed, weather and system condition.

Why Tires Matter | Safe stopping depends on road, tire, speed, weather and syst

RESEARCH LABORATORY ARCHIVE

Testing Vehicle Safety

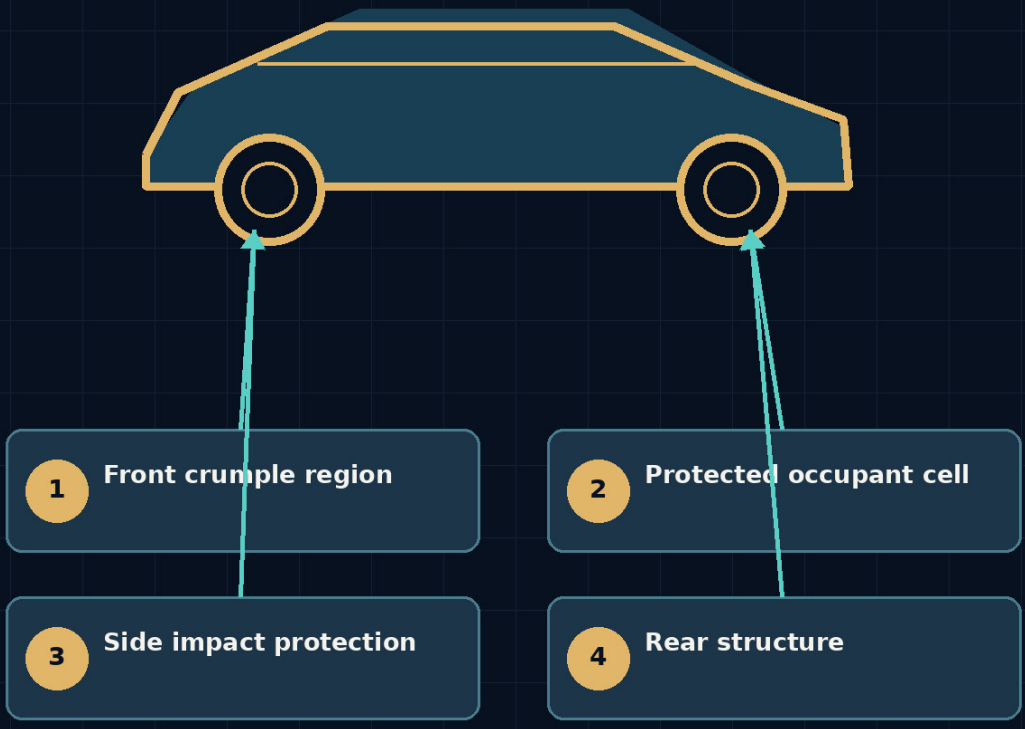


Crash testing records how structures and restraints perform in controlled scenarios.

SOURCE: U.S. Navy / GM vehicle laboratory • Public domain

CRASHWORTHINESS

Where Impact Energy Goes

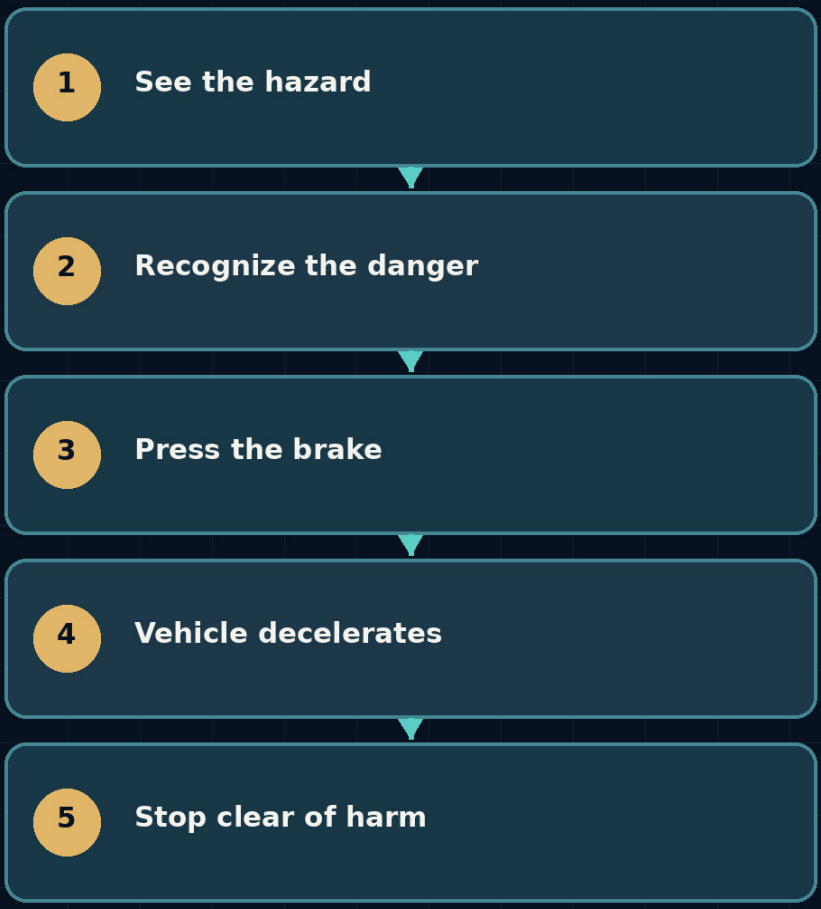


Designers use controlled deformation to manage impact energy.

Where Impact Energy Goes | Designers use controlled deformation to manage impact energy

REACTION + BRAKING

Stopping Distance



The total stop requires detection, reaction and physical deceleration.

Stopping Distance | The total stop requires detection, reaction and physical dec

PREVENT, PROTECT, RESCUE

Three Layers of Protection

01

Safe road design

02

Driver awareness

03

Collision warning

04

Seatbelts and airbags

05

Vehicle structure

06

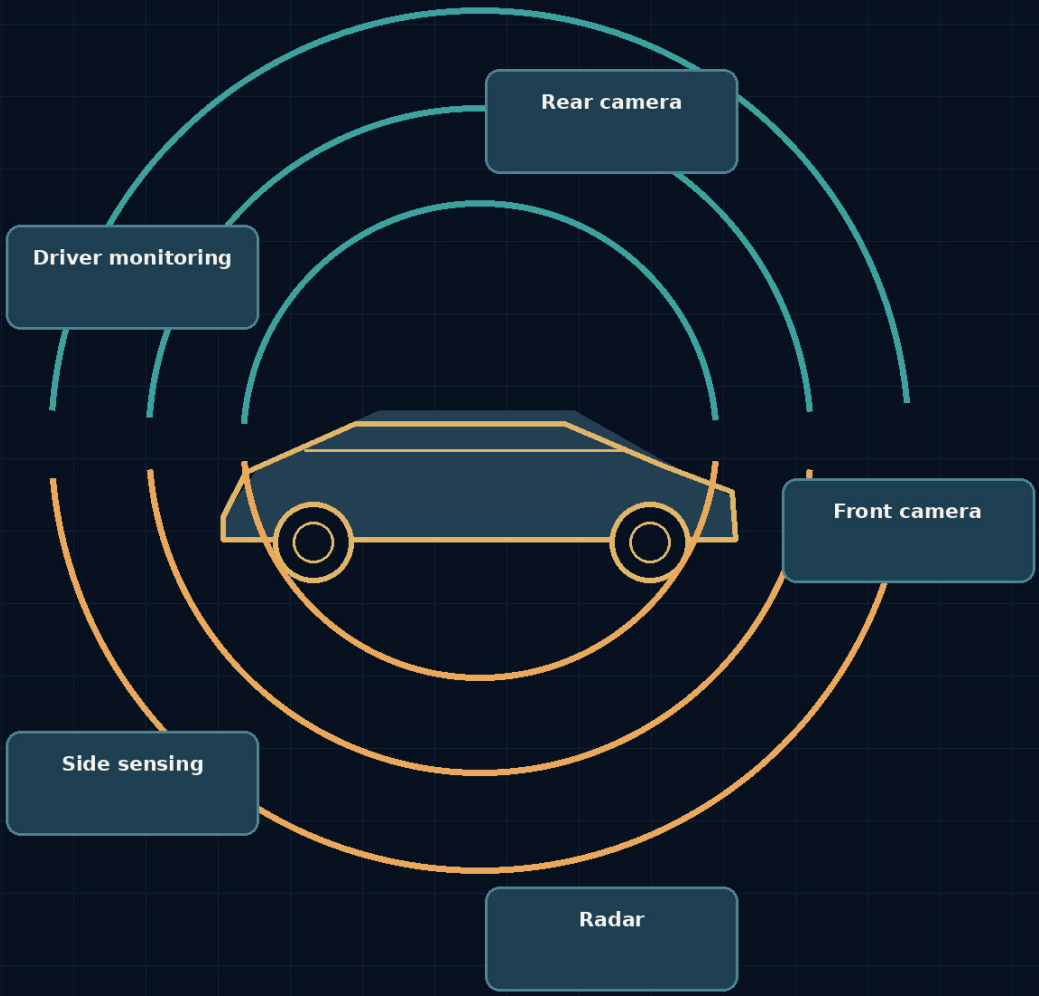
Emergency response

Avoiding a crash and protecting occupants are distinct safety tasks.

Three Layers of Protection | Avoiding a crash and protecting occupants are distinct safet

SENSORS ON THE VEHICLE

What ADAS Can Sense



Cameras, radar and ultrasonics have different strengths and limitations.

What ADAS Can Sense | Cameras, radar and ultrasonics have different strengths and

HUMAN OVERSIGHT REMAINS

Assistance Is Not Autonomy

01

Lane assist ≠ self-driving

02

Cruise control still needs care

03

Sensors can be obstructed

04

Weather changes performance

Feature names should not replace a clear understanding of system limits.

Assistance Is Not Autonomy | Feature names should not replace a clear understanding of sy

CONTEMPORARY MOBILITY

A Modern Electric Sedan



A current EV represents a different arrangement of power electronics and propulsion.

SOURCE: Tesla Model 3 • Aethonatic, CC0

ENERGY THROUGH THE CAR

An Electric Powertrain



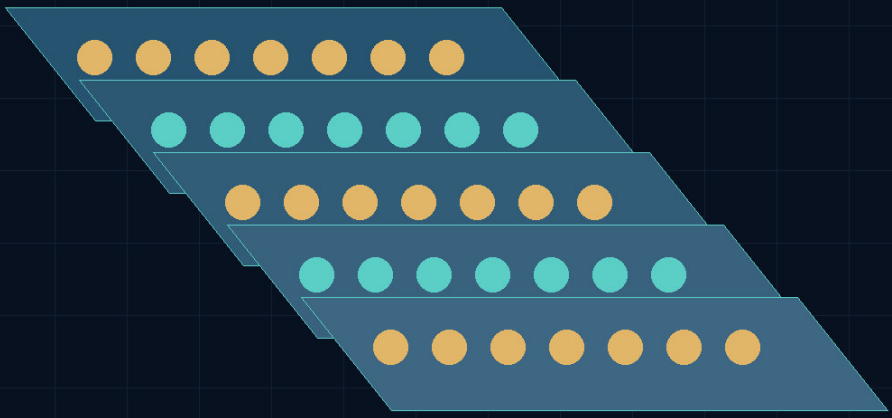
1. High-voltage battery
2. Inverter electronics
3. Electric drive motor
4. Gear reduction

The battery delivers DC electricity; the inverter drives an electric motor.

An Electric Powertrain | The battery delivers DC electricity; the inverter drives an

CELL → MODULE → PACK

Inside an EV Battery



01 **Individual cells**

02 **Grouped modules**

03 **Battery enclosure**

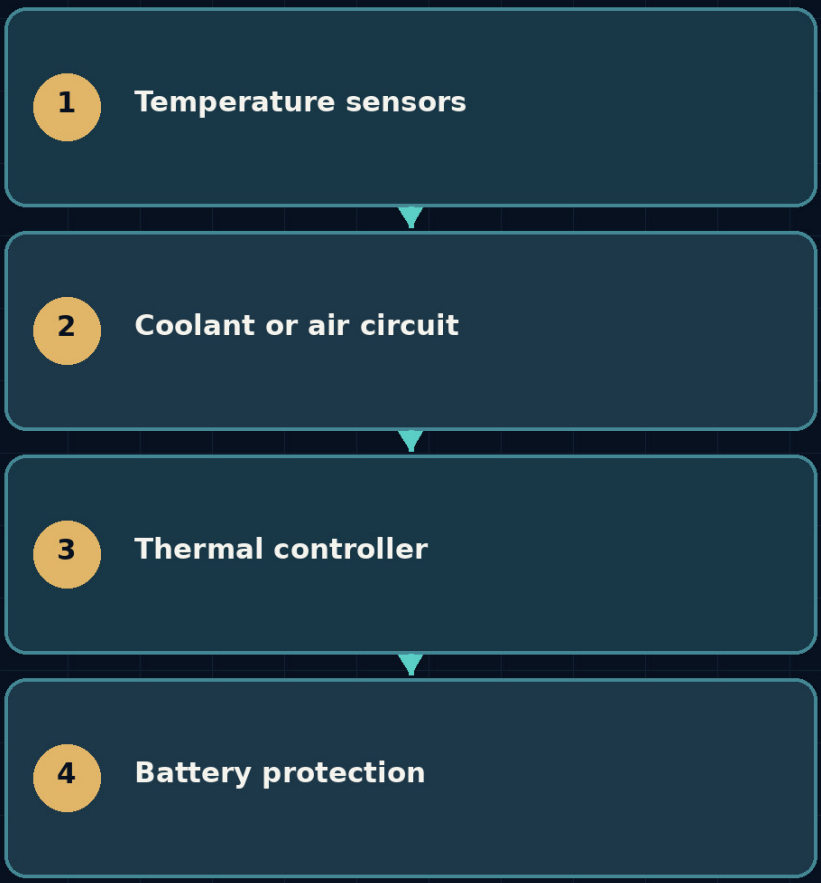
04 **Monitoring and safety**

Modern packs combine cells, monitoring electronics, protection and structural design.

Inside an EV Battery | Modern packs combine cells, monitoring electronics, protecti

THERMAL MANAGEMENT

Battery Temperature Control



Temperature management supports charging performance, life and safety.

Battery Temperature Control | Temperature management supports charging performance, life a

ELECTRICITY MEETS THE ROAD

Charging in the Real World



A charging location has to work for actual daily routes and parking patterns.

SOURCE: Electric car charging station • Fortunate4now, CC0

TWO ENERGY PATHWAYS

AC and DC Charging

01



AC • grid power to onboard charger

02



DC • external power electronics

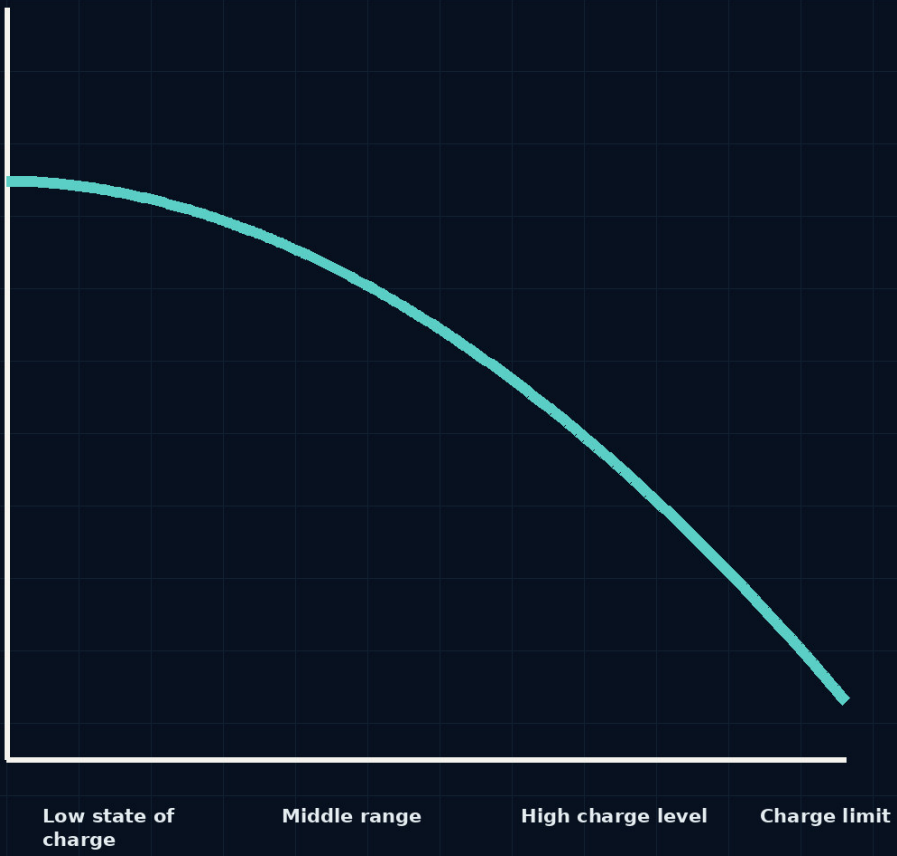
AC charging uses the onboard charger; DC fast charging supplies the battery more directly.

AC and DC Charging | AC charging uses the onboard charger; DC fast charging suppl

A QUALITATIVE TREND

Why Charging Slows

SCHEMATIC TREND • NOT A VEHICLE-SPECIFIC CLAIM



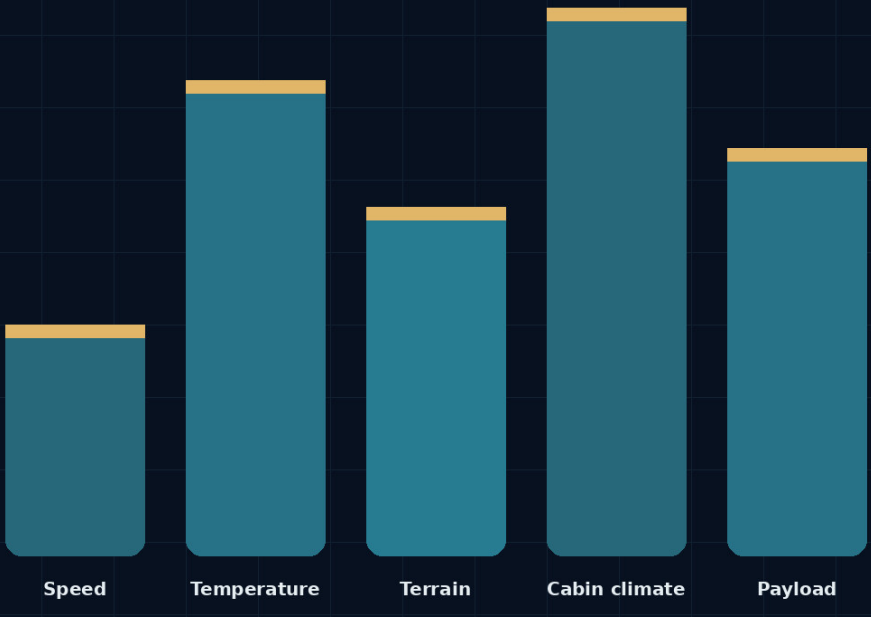
Rapid charging is often fastest during the lower part of a battery charge session.

Why Charging Slows | Rapid charging is often fastest during the lower part of a b

EVERYDAY CONDITIONS

What Affects Real Range

ILLUSTRATIVE CONCEPT — NOT MEASURED DATA

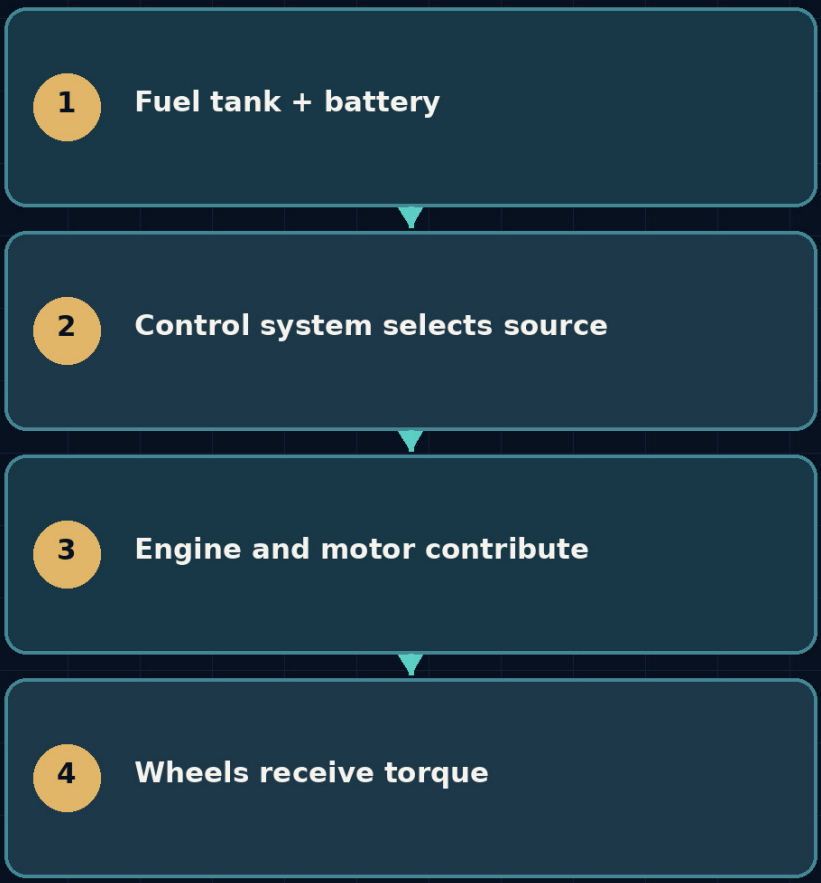


Range is not a fixed promise: road speed, weather and load change energy use.

What Affects Real Range | Range is not a fixed promise: road speed, weather and load c

TWO POWER SOURCES

The Hybrid Idea



Hybrid designs coordinate an engine, motor and battery to meet driving needs.

The Hybrid Idea | Hybrid designs coordinate an engine, motor and battery to me

LIFECYCLE PERSPECTIVE

No Technology Is Impact-Free

01

Material extraction

02

Vehicle manufacturing

03

Fuel or electricity supply

04

Vehicle use

05

Maintenance

06

End-of-life management

Materials, production, use and disposal all belong in an environmental comparison.

No Technology Is Impact-Free ↑ Materials, production, use and disposal all belong in an env

RELIABLE REPAIRS

The Service Journey



A good workshop validates a fault before recommending component replacement.

The Service Journey | A good workshop validates a fault before recommending compon

CONDITION AND MAINTENANCE

A Sensible Service Calendar

01

Tires and alignment

02

Braking system

03

Fluids where applicable

04

Software and recall checks

05

Battery or engine inspection

06

Lights and wipers

Follow manufacturer specifications rather than generic fixed intervals.

A Sensible Service Calendar | Follow manufacturer specifications rather than generic fixed

DASHBOARD LITERACY

Warning Lights Need Context

01

Engine warning

02

Oil pressure

03

Brake system

04

Charging fault

05

Tire pressure

06

Occupant restraints

A warning means a system needs attention, but urgency varies by the indicator.

Warning Lights Need Context | A warning means a system needs attention, but urgency varies

MORE THAN THE SHOWROOM PRICE

Total Ownership Cost

01

Purchase and financing

02

Insurance and registration

03

Fuel or electricity

04

Service and tires

05

Repairs and downtime

06

Depreciation

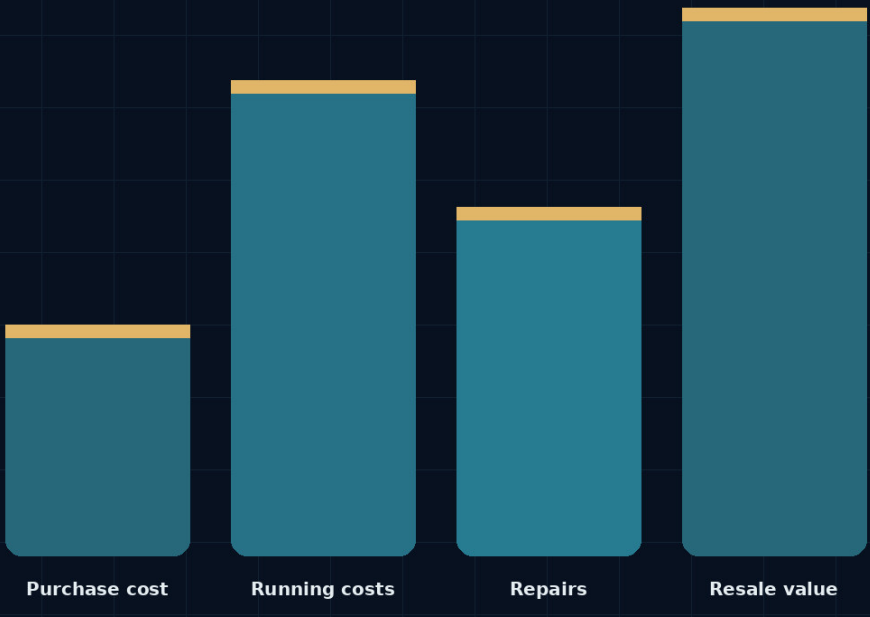
Use realistic expenses across the whole ownership period.

Total Ownership Cost | Use realistic expenses across the whole ownership period.

ILLUSTRATIVE COST BARS

Price Is Not Profit or Value

ILLUSTRATIVE CONCEPT — NOT MEASURED DATA



Total ownership may differ even when purchase prices are comparable.

Price Is Not Profit or Value | Total ownership may differ even when purchase prices are com

COMPARE COMMITMENTS

Financing Changes Cash Flow

01



Cash • pay upfront

02



Finance • scheduled payments

03



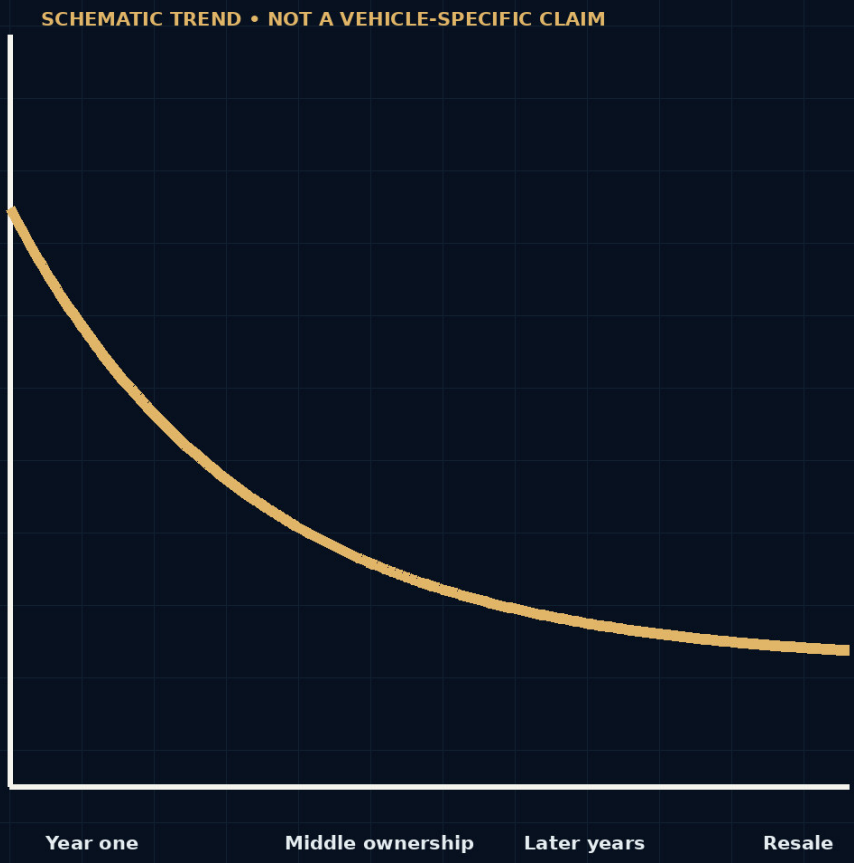
Lease • use with conditions

A low monthly payment can conceal fees, term length or a large final obligation.

Financing Changes Cash Flow ¶ A low monthly payment can conceal fees, term length or a lar

CONCEPT, NOT FORECAST

Depreciation Over Time

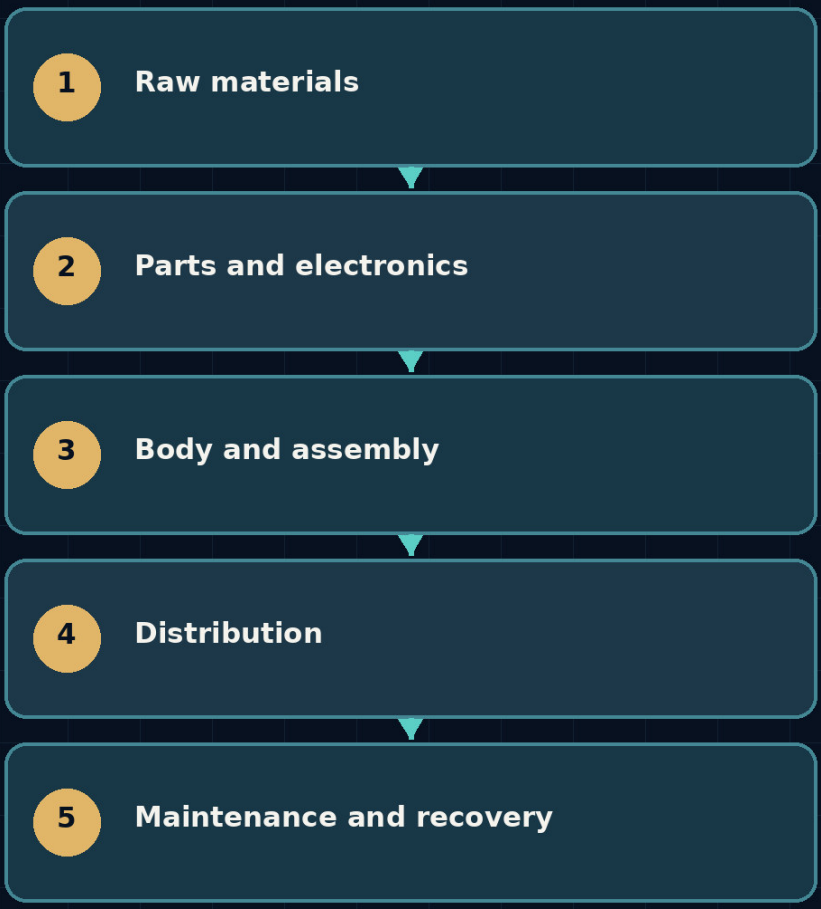


Market value often declines after purchase; exact curves vary widely.

Depreciation Over Time | Market value often declines after purchase; exact curves var

SUPPLY CHAIN VISUAL

How Cars Are Made



Vehicle production links raw materials, engineering, suppliers and assembly.

How Cars Are Made | Vehicle production links raw materials, engineering, supplie

MOBILITY FOR EVERYONE

Design for Accessibility

01

Comfortable entry

02

Reachable controls

03

Space for mobility aids

04

Clear visual feedback

05

Assisted transport

06

Usable pedestrian access

Entry height, door openings, controls and seating affect who can travel.

Design for Accessibility | Entry height, door openings, controls and seating affect who

SAFETY BEYOND VEHICLES

Roads Are Shared Places

01



Pedestrians and crossings

02



Cycling routes

03



Transit and vehicles

Intersections, crossings and public transport determine real mobility outcomes.

Roads Are Shared Places | Intersections, crossings and public transport determine real

THE MODERN DESIGN LANGUAGE

Electrification in Perspective

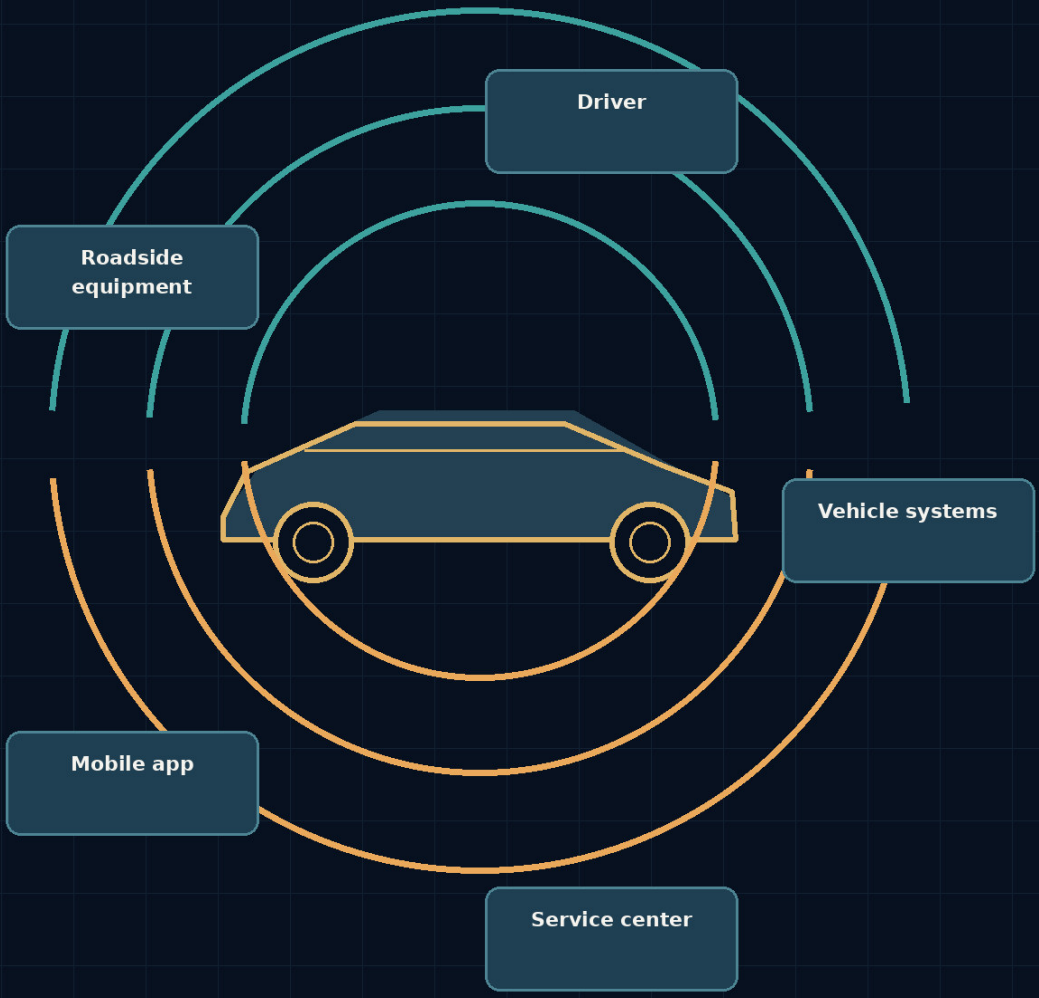


Modern body design balances efficiency, packaging, performance and consumer appeal.

SOURCE: Tesla Model 3 facelift • Wikimedia Commons CC0

DATA FLOWS AND SAFEGUARDS

The Connected Vehicle



Useful connectivity must be accompanied by privacy, security and clear controls.

The Connected Vehicle | Useful connectivity must be accompanied by privacy, security

CHOOSE FOR REAL LIFE

Your Mobility Decision Map

01 **Typical journey**

EXPLORE →

02 **Running costs**

EXPLORE →

03 **Service access**

EXPLORE →

04 **Safety needs**

EXPLORE →

05 **Energy availability**

EXPLORE →

06 **Real-world usability**

EXPLORE →

Match the vehicle to your routes, budget, safety needs and support network.

BETTER MOBILITY SYSTEMS

A Look Toward Tomorrow

01

Cleaner supply chains

02

Repairable electronics

03

Safer road users

04

Accessible mobility

05

Transparent automation

06

Accountable design

Future vehicles should be measured by their usefulness, safety and repairability.

A Look Toward Tomorrow | Future vehicles should be measured by their usefulness, safe

DOCUMENTED PHOTOGRAPHS ONLY

Photo Credits and Sources

01

1900 Benz engraving • public domain

02

1908 Ford advertisement • public domain

03

Ford 1928 factory • public domain

04

Modern car photos • CC0

05

Charging and engine photos • CC0

06

Crash test • U.S. Gov public domain

Archival and contemporary photographs are credited below. Other diagrams are original illustrations.

Photo Credits and Sources | Archival and contemporary photographs are credited below. Ot