

Approaches for market penetration of VIPV in the EU

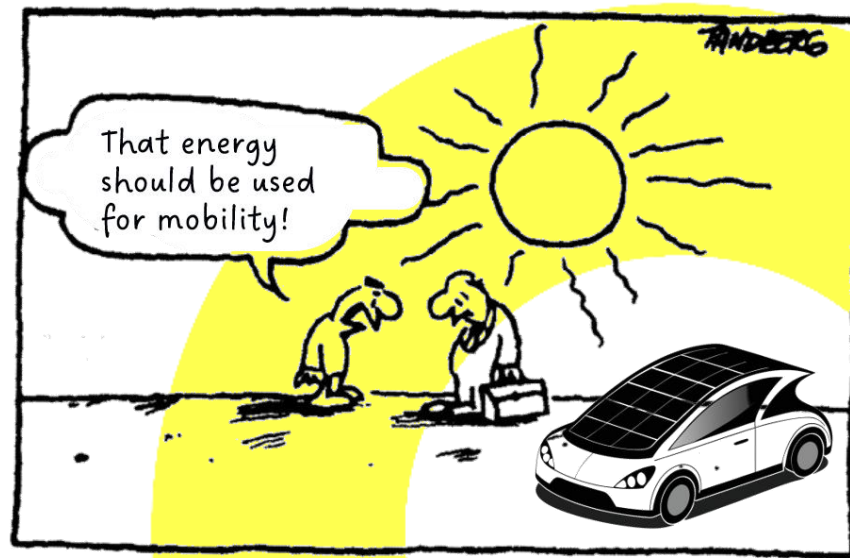
From Demonstrations to Deployment:
How Can VIPV Become Mainstream in Europe

IEA PVPS Task 17 | EU PVSEC 2026

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TNO and board member of
ASOM

asom

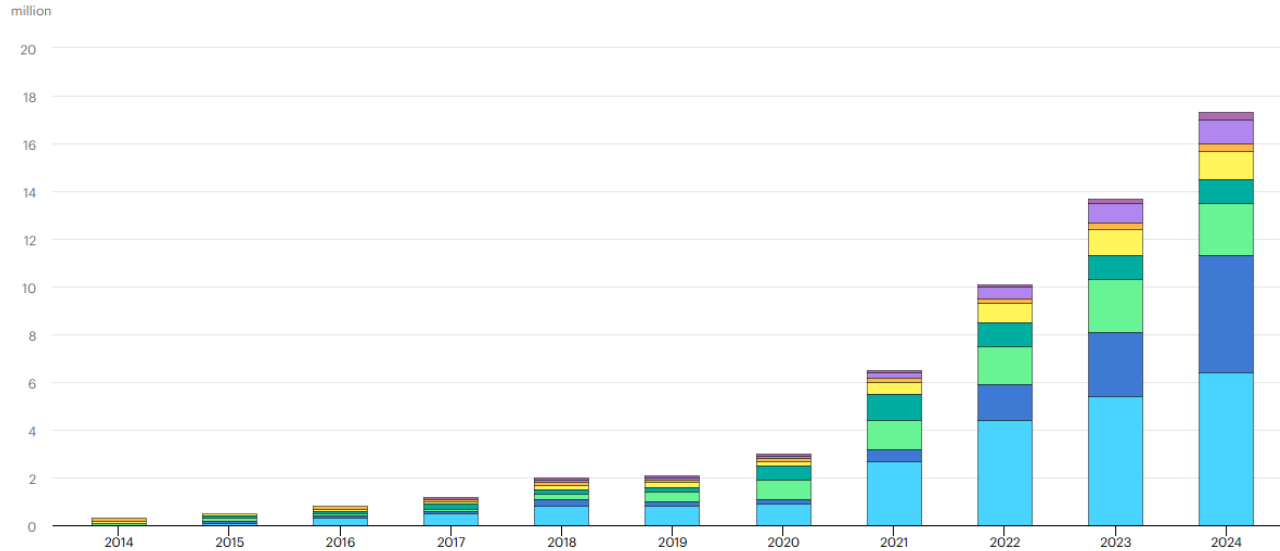
Alliance for
Solar Mobility



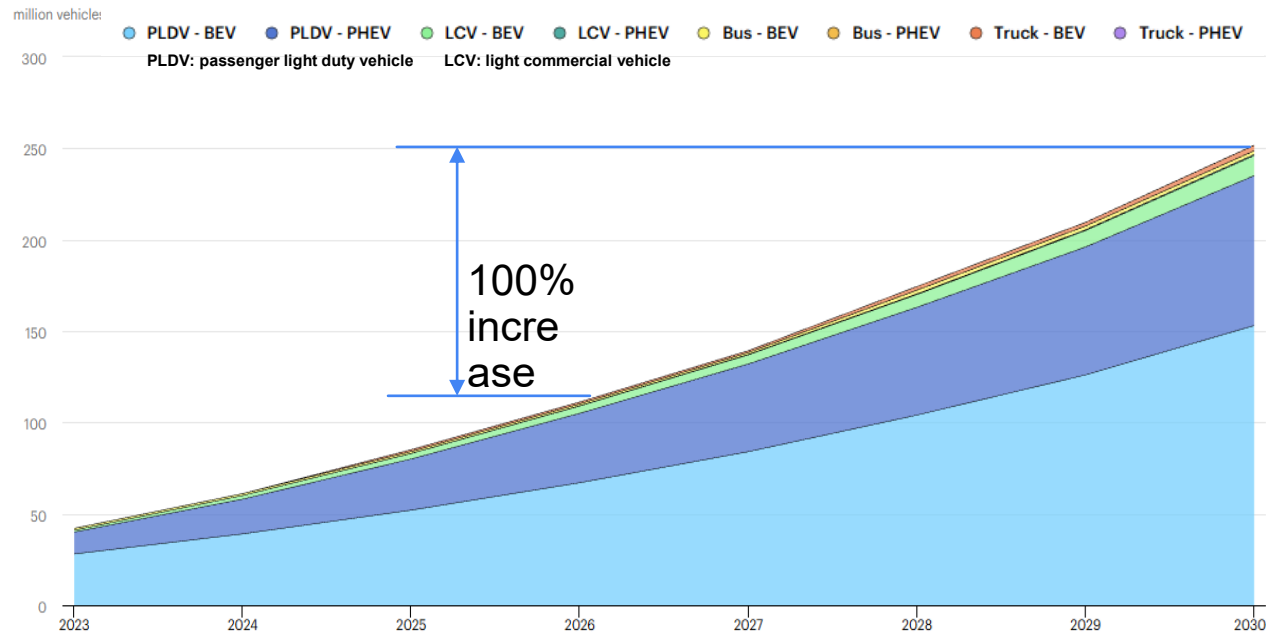
VIPV foundation and context

Electrification of transport

Global electric car sales, 2014-2024



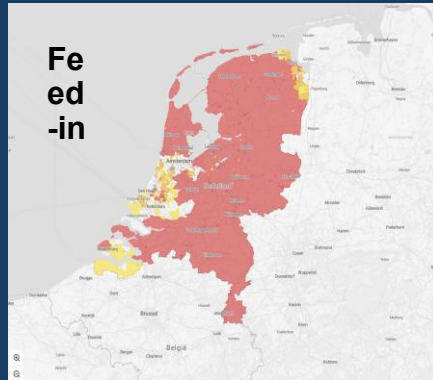
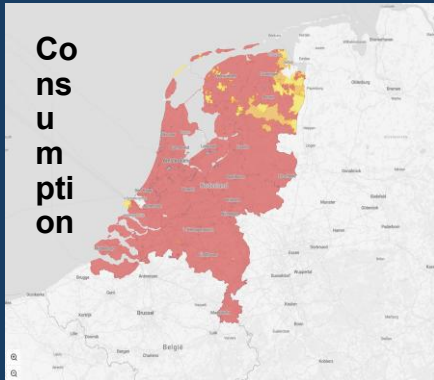
Stock of other electric vehicles in the Stated Policies Scenario, 2024-2030



Large investments in charging infrastructure and renewable energy supply needed

Bottlenecks

Grid Congestions



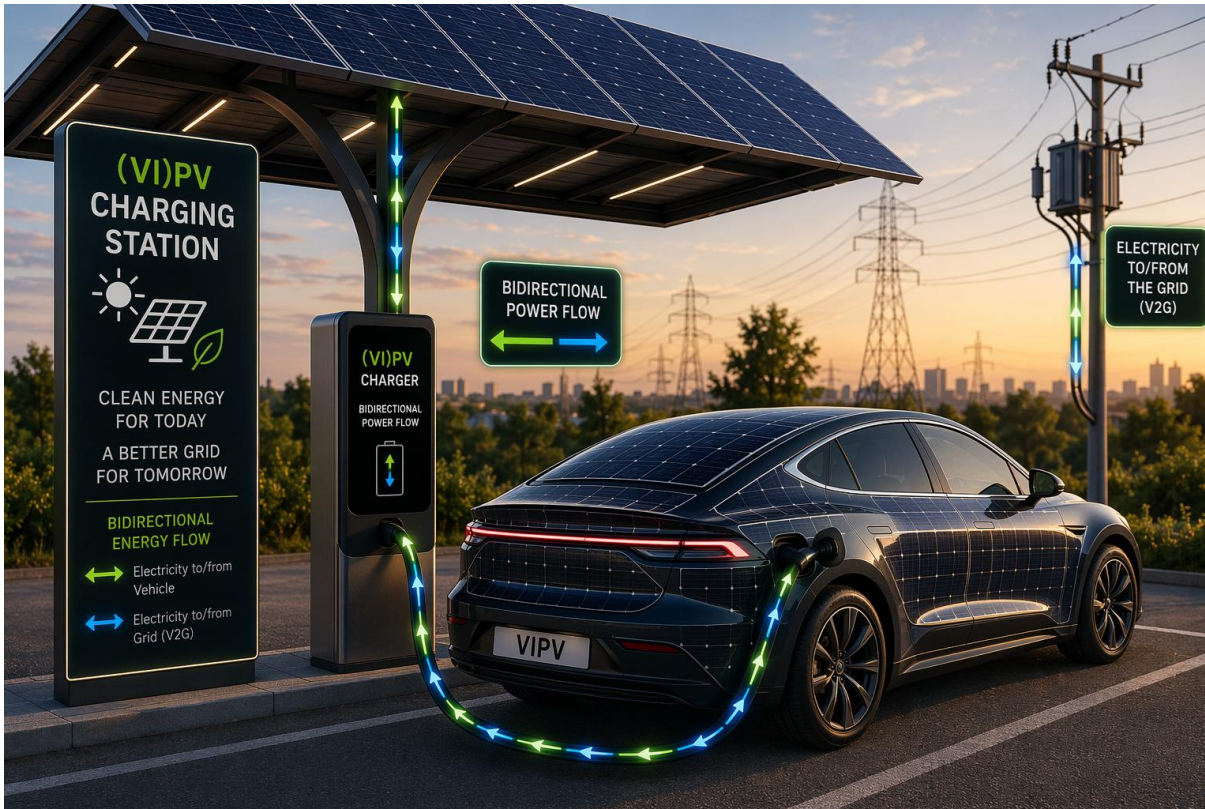
<https://capaciteitskaart.netbeheernederland.nl/>

Long permit trajectories

High Costs

VIPV support

asom Alliance for
Solar Mobility



VIPV will
**not solve
the bottlenecks**

but
**can help relieve
the bottlenecks**

Market potential of VIPV

Market potential of VIPV

Largest for use cases where solar energy translates directly into operational value

Value mechanisms

Quantitative

- | | |
|-----------------------------|---|
| • TCO | CAPEX and OPEX |
| • CO ₂ emissions | external electricity savings as a result of VIPV converted into avoided emissions |
| • Payback period | due to reduced electricity consumption from the grid |
| • Convenience | % reduction in charging moments |

SolarMoves study

Market potential of VIPV

Largest for use cases where solar energy translates directly into operational value

Value mechanisms

Qualitative: 0, 1, 2

- Parking location independence
- Autonomy
- Eco-friendly image
- Range
- Battery lifetime
- Regulatory compliance
- Brand image
- Grid utilization
- Investments in infrastructure

SolarMoves study

Stakeholder: Vehicle owners

Factor	Desired change	Delta EV & VIPV 2030										
		Small passenger car				Medium sized passenger car				SUV		
		Occasional use	Daily urban commute	Daily peri-urban commute	Long-distance highway travel	Car sharing	Daily urban commute	Daily peri-urban commute	Long-distance highway travel	Daily urban commute	Daily peri-urban commute	Long-distance highway travel
TCO [€ / 5 y]	☒	-136	-64	-206	-480	-209	-144	-249	-464	-403	-676	-1,220
Payback period [y]	☒	3.7	4.3	3.3	2.4	3.4	3.9	3.4	2.7	2.9	2.3	1.7
CO ₂ emission [%]	☒	-50%	-47%	-35%	-18%	-16%	-46%	-31%	-16%	-62%	-43%	-21%
Autonomy	☒	2	2	2	1	1	2	2	1	2	2	1
Convenience	☒	48%	43%	31%	11%	10%	47%	32%	12%	53%	41%	10%
Range	☒	0	0	0	0	0	0	0	0	0	0	0
Battery lifetime	☒	0	0	0	0	0	0	0	0	0	0	0
Eco-friendly image	☒	2	2	2	2	2	2	2	2	2	2	2
Parking location independency	☒	2	2	2	1	2	2	1	1	2	1	1

Stakeholder: Vehicle owners vans

Factor	Desired change	Delta EV vs. VIPV 2030			
		Small van		Large van	
		Local distribution	Regional distribution	Local distribution	Regional distribution
TCO [€ / 5 year]	☒	-554	-914	-732	-1210
Payback period [years]	☒	2.7	2.1	2.7	2.0
CO ₂ emission [%]	☒	-21%	-18%	-16%	-22%
Autonomy	☒	1	0	0	0
Convenience	☒	14%	12%	7%	13%
Range	☒	0	0	0	0
Battery lifetime	☒	0	0	0	0
Eco-friendly image	☒	2	2	2	2
Parking location independency	☒	0	0	0	0

Stakeholder: Vehicle owners buses

Factor	Desired change	Delta EV vs. VIPV 2030			
		HB11	HB12	HB22	HB23
		<i>Low-floor bus</i>		<i>High-floor bus</i>	
		Urban public transport service	Peri urban public transport service	Regional public transport	Long-distance highway travel
TCO [€ / 5 y]	☒	-505	-315	-712	-1,855
Payback period [Y]	☒	4.0	4.3	3.6	2.6
CO ₂ emission [%]	☒	-1%	-2%	-2%	-1%
Autonomy	☒	0	0	0	0
Convenience	☒	0%	0%	0%	0%
Range	☒	0	0	0	0
Battery lifetime	☒	0	0	0	0
Eco-friendly image	☒	2	2	2	2
Parking location independency	☒	0	0	0	0

Stakeholder: Vehicle owners EV trucks

Factor	Desired change	Delta EV vs. VIPV 2030			
		Rigid truck		Tractor-trailer	
		Urban distribution	Regional distribution	Regional distribution	Long-haul freight transport
TCO [€ / 5 year]	☒	€123	€-242	€51	€-4,591
Payback period	☒	>5	4.6	>5	2.8
CO ₂ emission [%]	☒	-6%	-5%	-7%	-3%
Autonomy	☒	0	0	0	0
Convenience	☒	0%	0%	0%	0%
Range	☒	0	0	0	0
Battery lifetime	☒	0	0	0	0
Eco-friendly image	☒	2	2	2	2
Parking location independency	☒	0	0	0	0

Stakeholder: Vehicle owners ICE trucks

Factor	Desired change	Delta ICE vs. VIPV 2030			
		HT11	HT12	HT22	HT23
		Rigid truck		Tractor-trailer	
		Urban distribution	Regional distribution	Urban distribution	Regional distribution
TCO [€ / 5 year]	☒	€ -5,239	€ -8,105	€ -14,092	€ -32,452
Payback period [years]	☒	1.1	1.0	1.1	0.7
CO ₂ emission [%]	☒	6.2%	4.4%	9.2%	5.2%
Battery lifetime	☒	0	0	0	0
Noise reduction / comfort	☒	0	1	0	2
Eco-friendly image	☒	2	2	2	2
Parking location independency	☒	0	0	0	0

Market potential of VIPV: Conclusions

Depends strongly on vehicle type and use case

Passenger cars

- Largest cost reduction and shortest payback time for long range use cases
- Largest convenience for low-medium range use cases
- Strong CO2 reduction across all archetypes

Vans

- Largest cost reduction and shortest payback time for long range use cases
- Marginal increase in convenience
- Substantial CO2 reduction across all archetypes

Buses

- Largest cost reduction and shortest payback time for long range use cases
- No increase in convenience
- Minimal CO2 reduction across all archetypes

EV trucks

- Largest cost reduction and shortest payback time for long range use cases
- No increase in convenience
- Marginal CO2 reduction across all archetypes

ICE trucks

- Good to great cost reduction and payback time across all archetypes and use cases
- No increase in convenience
- Substantial CO2 reduction across all archetypes
- Noise reduction and comfort improvement

Current status: Where are we today?

Current Status: Where Are We Today?

The bottleneck is shifting

From cell efficiency and energy yield towards qualification, certification, OEM risk, supply chains and value capture.

Biggest barriers are no longer PV efficiency but ecosystem integration



Maturity dimension

Technology

Reliability

Manufacturing

Standards

Business models

Mass adoption

Market Maturity Snapshot by Segment

Maturity dimension	Trucks & trailers	Buses	Vans	Premium passenger cars
Technology	Proven	Proven	Proven	Proven
Reliability	Proven	Proven	Proven	Proven curved glass/glass
Manufacturing	Commercial	Commercial	Commercial	Being developed
Evaluation Standards	Under development in discussion with IEA-PVPS Task 17			
Business models	Mature	Mature	To be validated	To be validated
Mass adoption	Starting	Starting	Currently still limited	Currently still limited

— Segment-level maturity assessment to be completed.

What Europe Can Do

Policy & ecosystem levers

- Harmonised VIPV standards
- Support for pilot fleets
- Public procurement programmes
- Recognition in CO₂ / sustainability schemes
- PV–automotive industrial partnerships
- Energy-system integration



Europe has the right ingredients; the challenge is to connect vehicle regulation, PV standards and clean-energy policy



Roadmap for Europe: climbing the deployment mountain

2040 | Summit

Mainstream solar mobility

VIPV as common option, integrated with smart charging and V2G

2030-2035 | Camp 3

OEM integration & scale

Automotive manufacturing volumes and cost reduction

2029 | Camp 2

Proven business cases

IIICE trucks, vans, passenger cars

2027-2028 | Camp 1

Reliability, standards & homologation

Durability validation and certification pathways

2026

Technology validation

Pilots, demonstrators, first commercial products

Parallel progress in technology qualification, business-case proof, OEM commitment and policy support.

Conclusions

- 1 Technology is ready enough to deploy**
The next phase is about qualification, integration and confidence, as well as recognition in subsidies for CO2 credits.
- 2 Commercial and specialty vehicles are the gateway**
Business case present. Increasing demand to build confidence. Fleet economics can create the first credible market pull.
- 3 Europe needs a coordinated ecosystem approach**
Standards, regulation, OEM engagement, subsidies and industrial partnerships must advance together.

