Transition to a Low Carbon Future

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SMART STREET

Innovative voltage control

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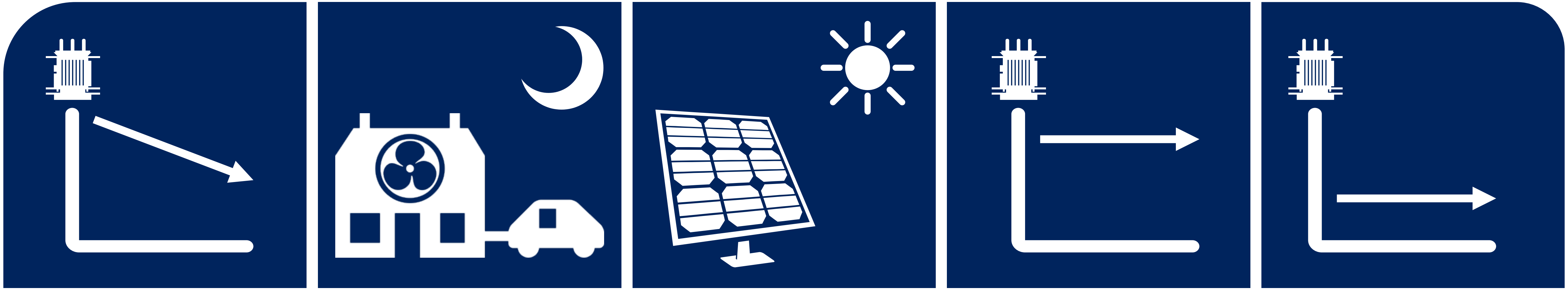
Background



Historic networks have no active voltage regulation

Increased demand

Increased generation

Smart Street stabilises voltage and optimises power flows

Conservation voltage reduction

Project overview

£11.5m, four-year innovation project	Started in January 2014 and finished in April 2018	Quicker connection of LCTs Lower energy bills Improved supply reliability	Trials period January 2016 – December 2017	Extensive customer engagement programme throughout project

Trial overview

Six primary substations
67,000 customers
11 HV circuits – five closable HV rings

Three pole-mounted HV capacitors
Three ground-mounted HV capacitors

38 distribution substations
Five OLTC transformers

Five substation capacitors
79 LV circuit capacitors

Research overview

Quantified the voltage optimisation and loss reduction techniques used in Smart Street	Proved the benefits of meshed networks and the effects on power quality	Quantified the cost benefits and carbon impact related to the Smart Street solution

Models and scenarios

Universities created models of network – used measured data to validate

Modelled 54 scenarios

Three networks

Dense urban

Urban

Rural

Three optimisation modes

1. OLTCs
2. OLTCs and capacitors
3. OLTCs, capacitors and meshing

Two day types

Winter weekday

Summer weekday

Three years

2017

2035

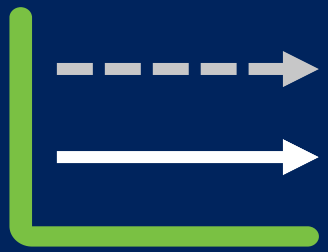
2050

Consumption and loss reduction

		Energy Consumption Reduction (%)			Losses Reduction (%)		
		2017	2035	2050	2017	2035	2050
Dense Urban	Summer	6.4	6.9	7.2	8.1	10.3	7.0
	Winter	6.5	7.0	7.1	8.7	11.0	3.7
Urban	Summer	7.2	7.8	7.1	8.7	10.4	2.3
	Winter	7.8	8.5	8.1	9.8	12.2	7.1
Rural	Summer	6.4	7.0	7.0	10.8	11.6	5.0
	Winter	6.7	7.3	7.2	13.0	15.0	11.5

High level conclusions

Optimisation benefits (energy)

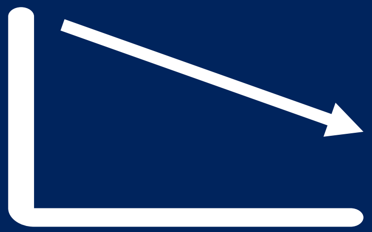


6-8% voltage reduction

5.5 – 8.5% energy reduction

All networks similar energy reduction

Optimisation benefits (losses)



Up to 15% loss reduction

Rural network has highest loss reduction

Trade off between loss and energy consumption reduction

Does exist but depends on load composition

Energy consumption dominates

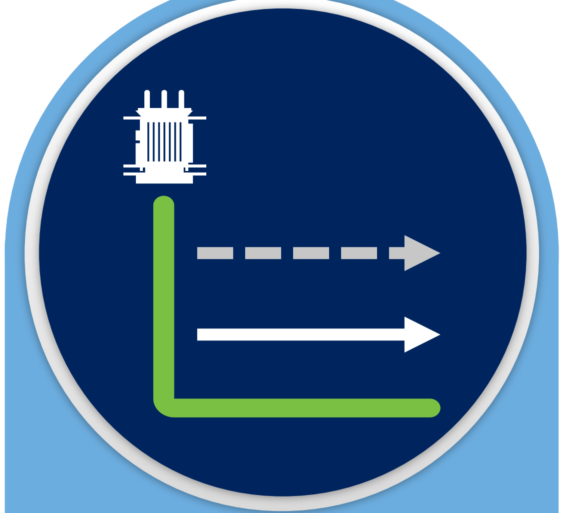
Carbon benefits

Reductions of 7% to 10% with a full application of Smart Street

Overall impact of Smart Street trials

Perception of power quality	Experience of SDIs	Fault data	Smart Street benefits	The hypothesis
Perceptions driven by exposure to power cuts Minimal differences re frequency and/or duration On balance positive changes	Not associated with a reduction in power quality Do not negatively impact customers’ power quality perceptions	SDIs were generally linked to network faults unassociated with the trials or with equipment installation	Generally customers perceived the Smart Street project to have positive or at least neutral implications	Customers in the trial area have not perceived any changes in their electricity supply when the Smart Street method is applied

Outcomes



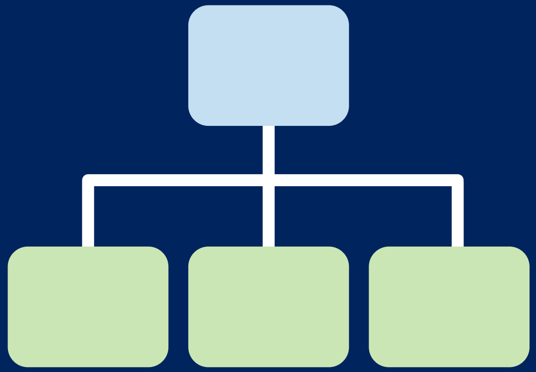
Monitored and actively optimised LV network

Proven that techniques save energy

Potential deferment of reinforcement

Associated carbon equivalent savings

Learning points – system



System architecture

Integration with existing SCADA system

Use of single line diagram

Learning points – equipment

Communications

Water ingress

Cabinet design and location

Enclosure size

Learning points – voltage control

Communications reliability

OLTC ‘safe’ setpoint

LV volt drop not as expected

Capacitor banks better suited to rural networks

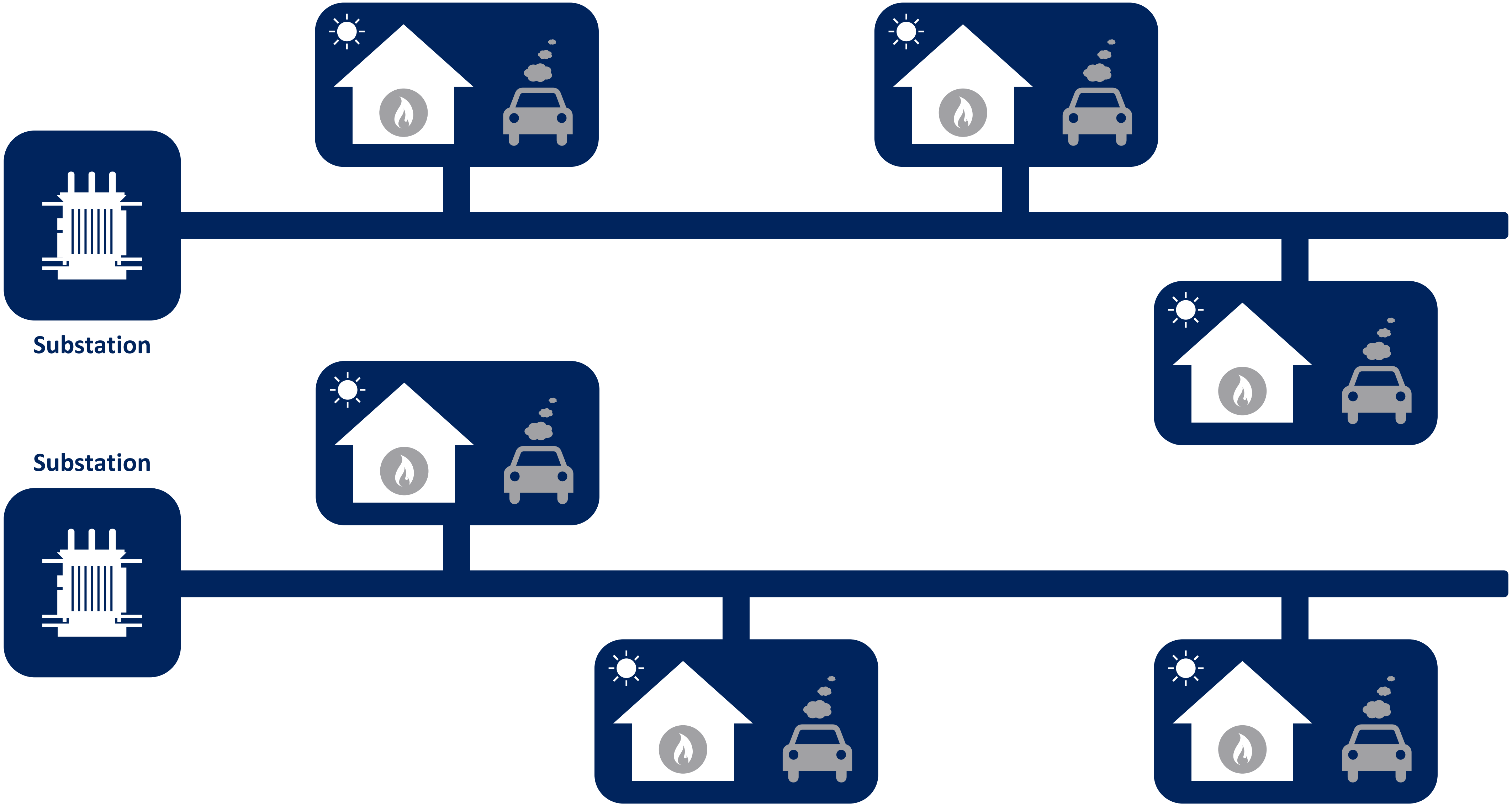
Learning points - meshing

Reduces voltage issues	Improves asset utilisation	Reduces losses	Increases fault levels	Customer benefit over permanent connection

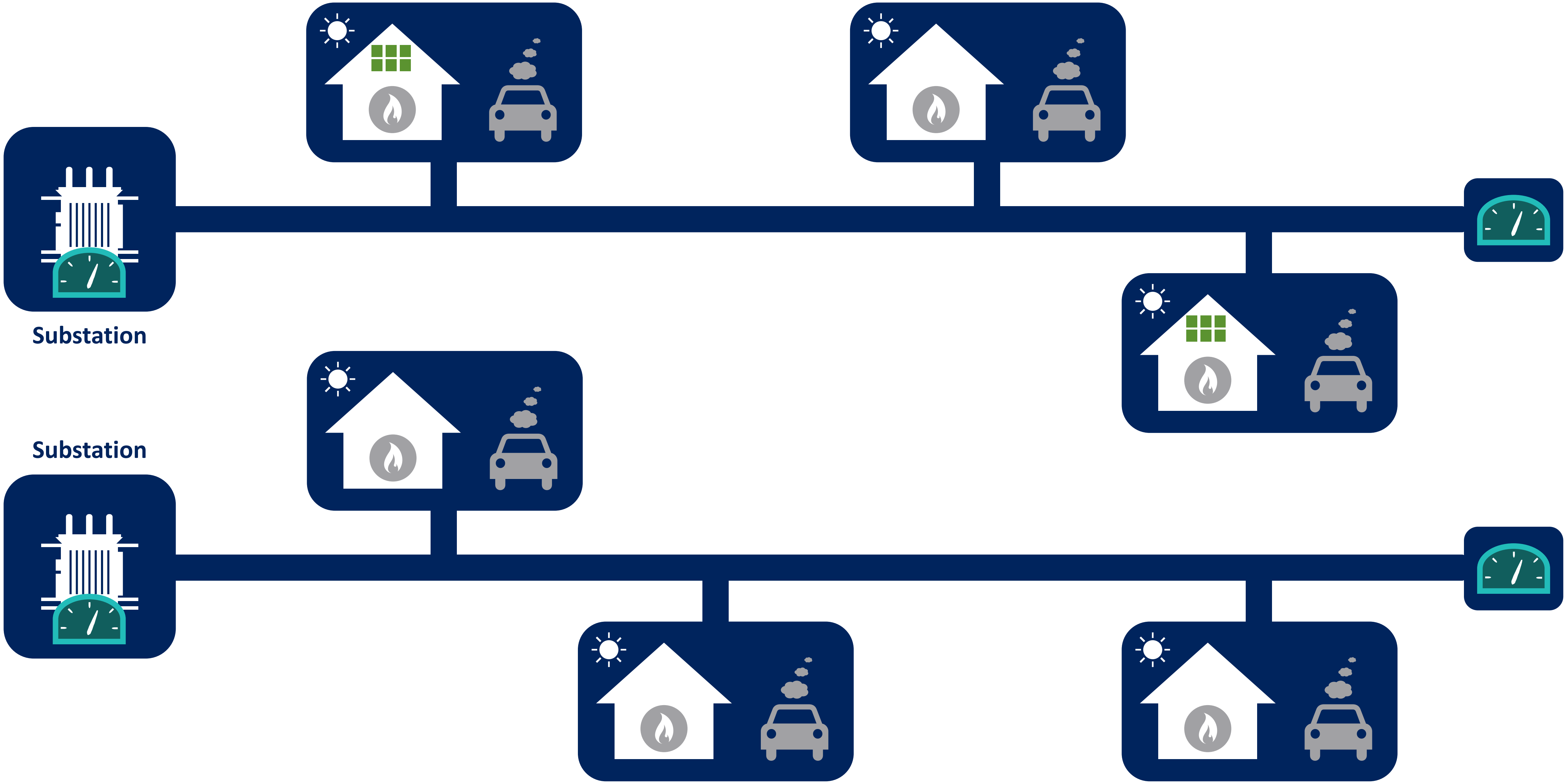
Policy changes

LV design	OLTC	Connections	Training
Is planning tool correct?	Modify specification	Update connection process for LCTs	New procedures and equipment

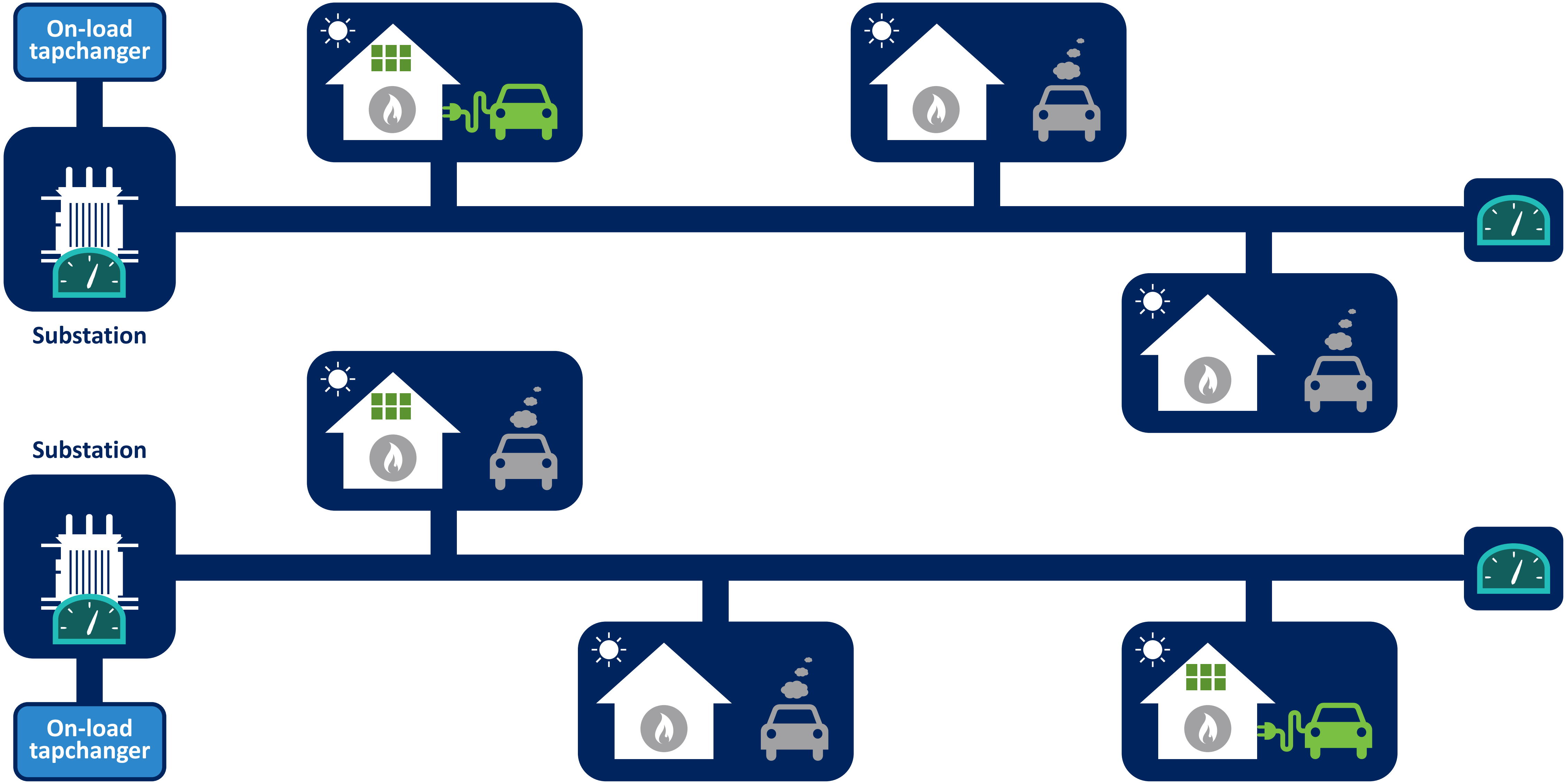
Historic distribution network



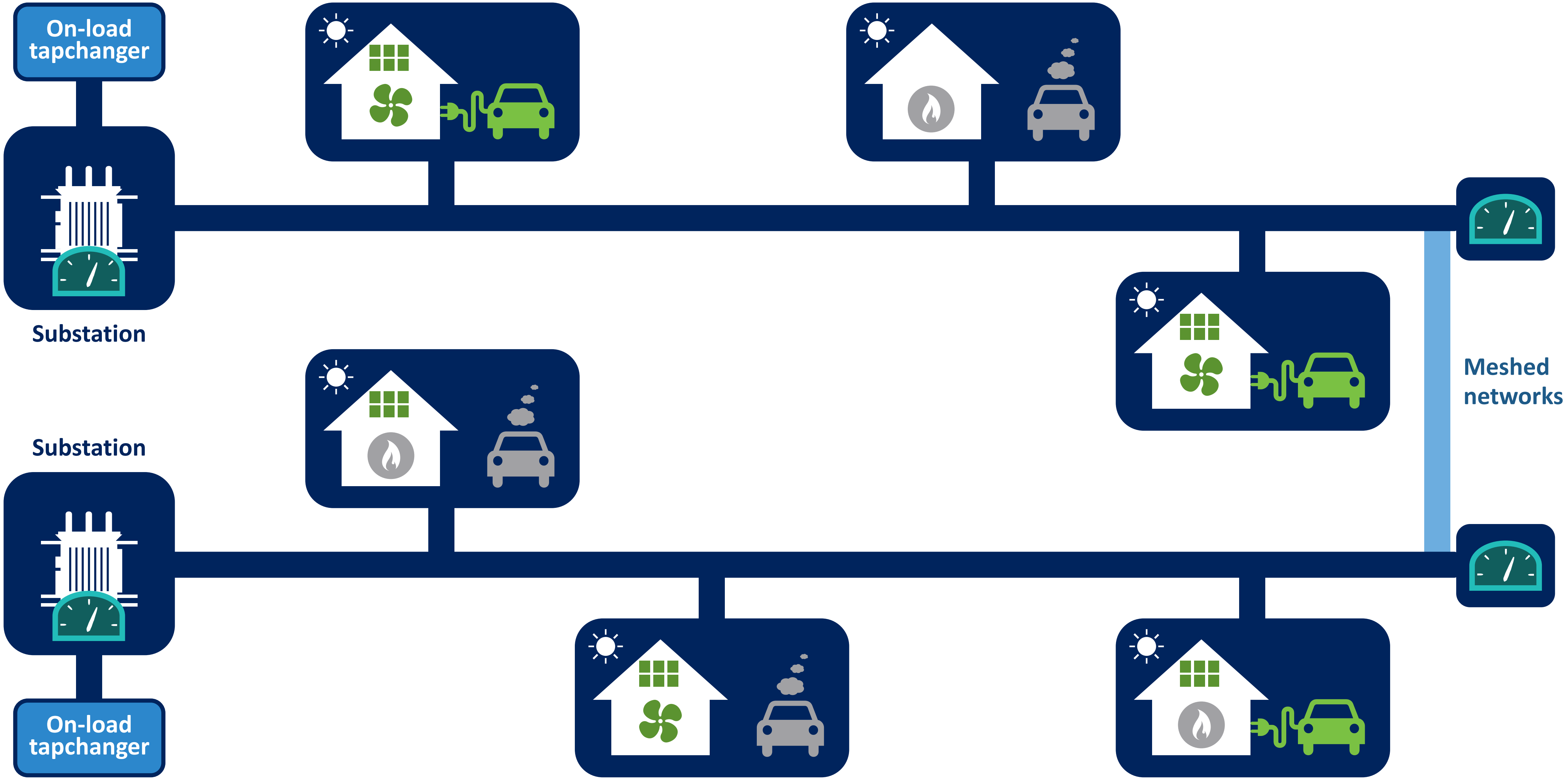
Network – today



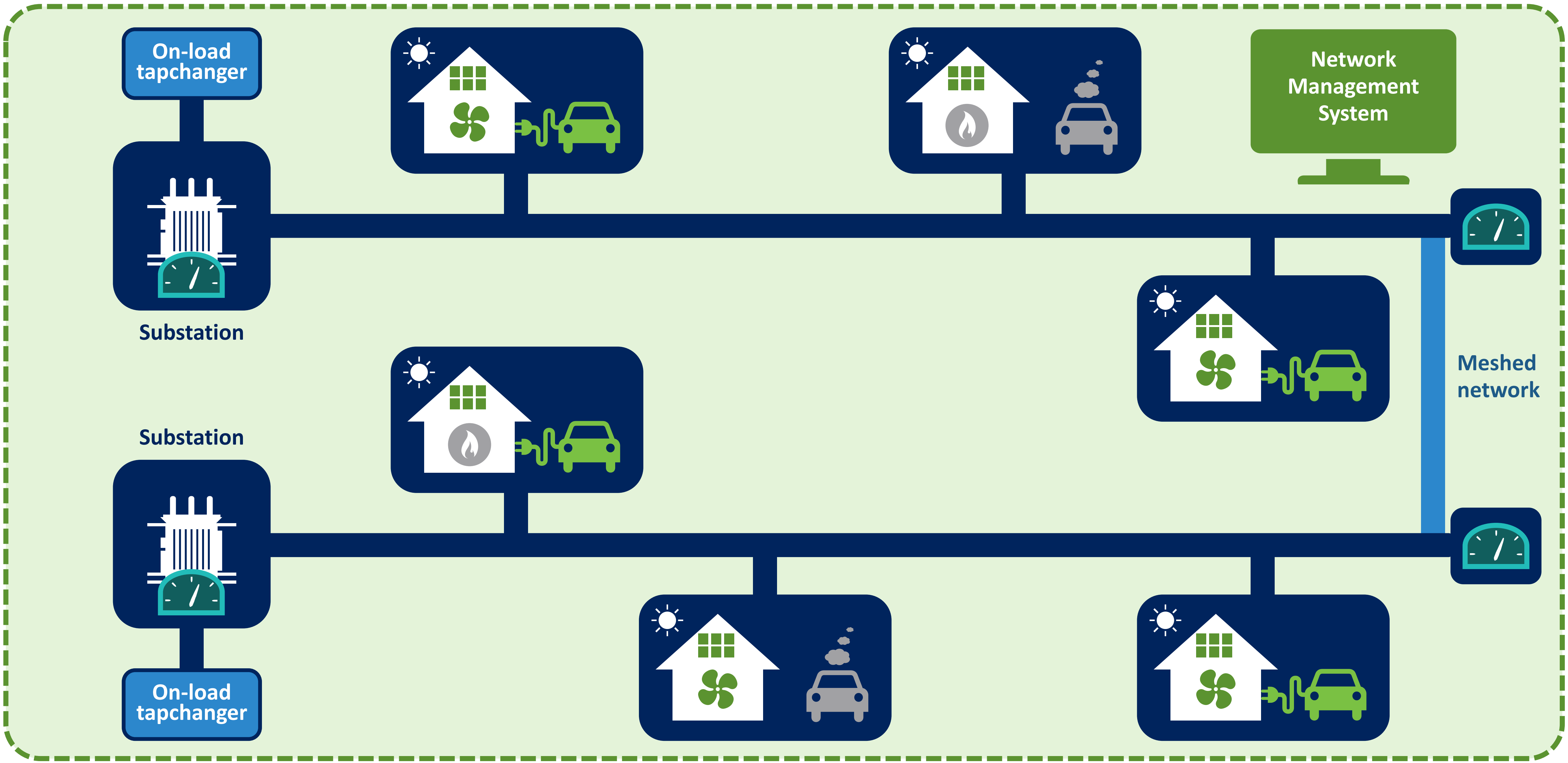
Future network – 1



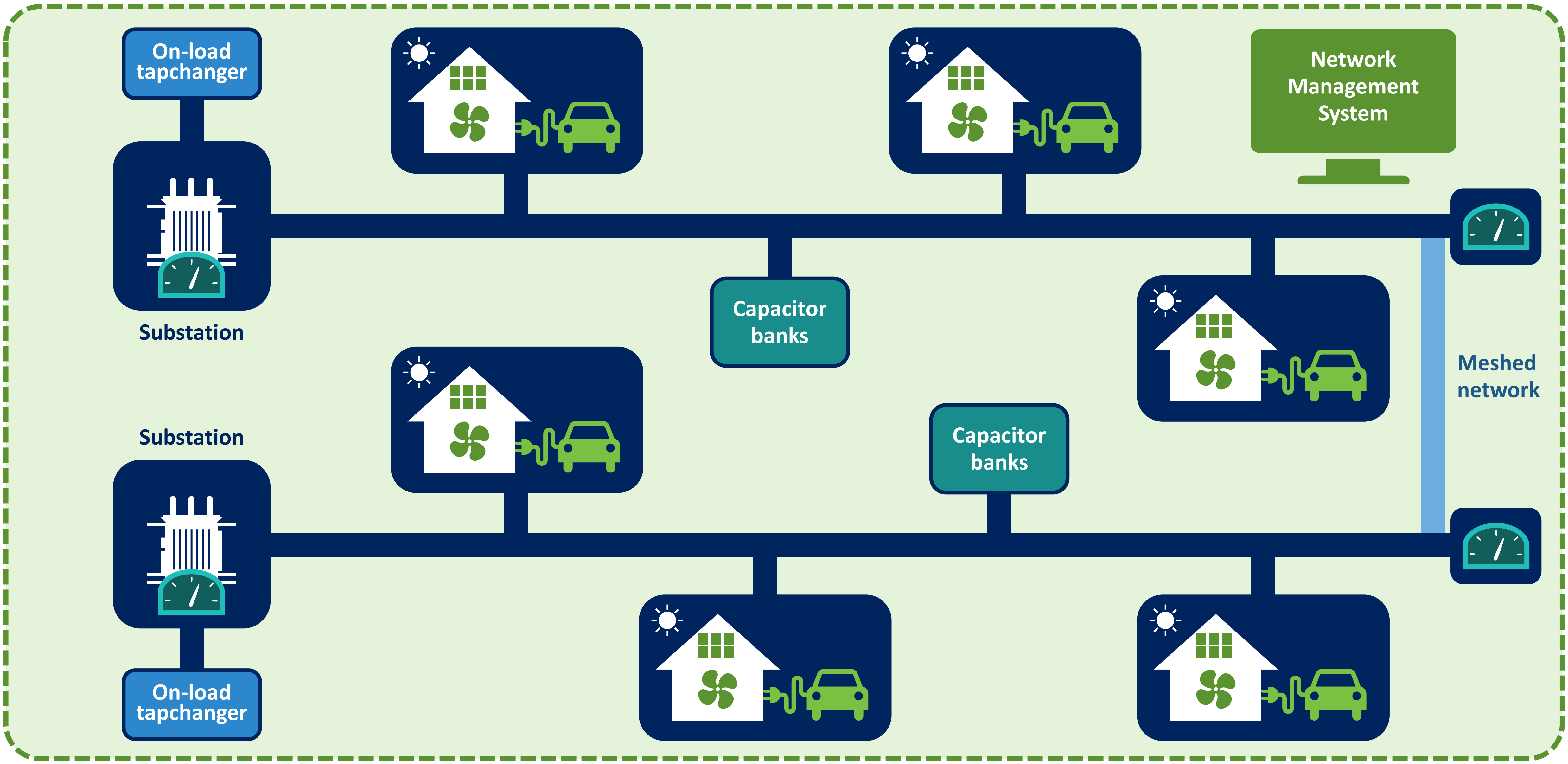
Future network – 2



Future network – 3



Future network – 4



Summary

- OLTCs provide benefits
- Operation of devices proven
- Software needs refinement

Technology

Trials

- Energy savings up to 8.5%
- Loss reduction up to 15%
- Active interconnection benefits quantified

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Carbon Footprint

Customer Benefits

- Faster LCT adoption
- Carbon emissions reduced by up to 10%
- Re-usable technology

- Lower energy bills
- More reliable supply
- Reinforcement savings
- No impact on supply

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