Institute for Sustainable Futures

The emerging HEMS market & interactions with behind-the-meter interoperability

Institute for Sustainable Futures (ISF)

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Dr Ed Langham

With thanks to colleagues Dr Matt Daly, Dr Farzan Tahir, Sophie Allen, Dr Chris Briggs & Dr Gabrielle Kuiper

What do we mean by Home Energy Management System (HEMS)?

…systems that can connect to **multiple residential energy devices** and a communications network to **provide monitoring and control, optimising** household energy storage, generation and consumption for the benefit of the household and the broader energy system

Connects to loads and energy resources:

- HWS, HVAC, homes appliances, smart thermostats, plugs, lights etc, and
- Solar PV, batteries, EVs

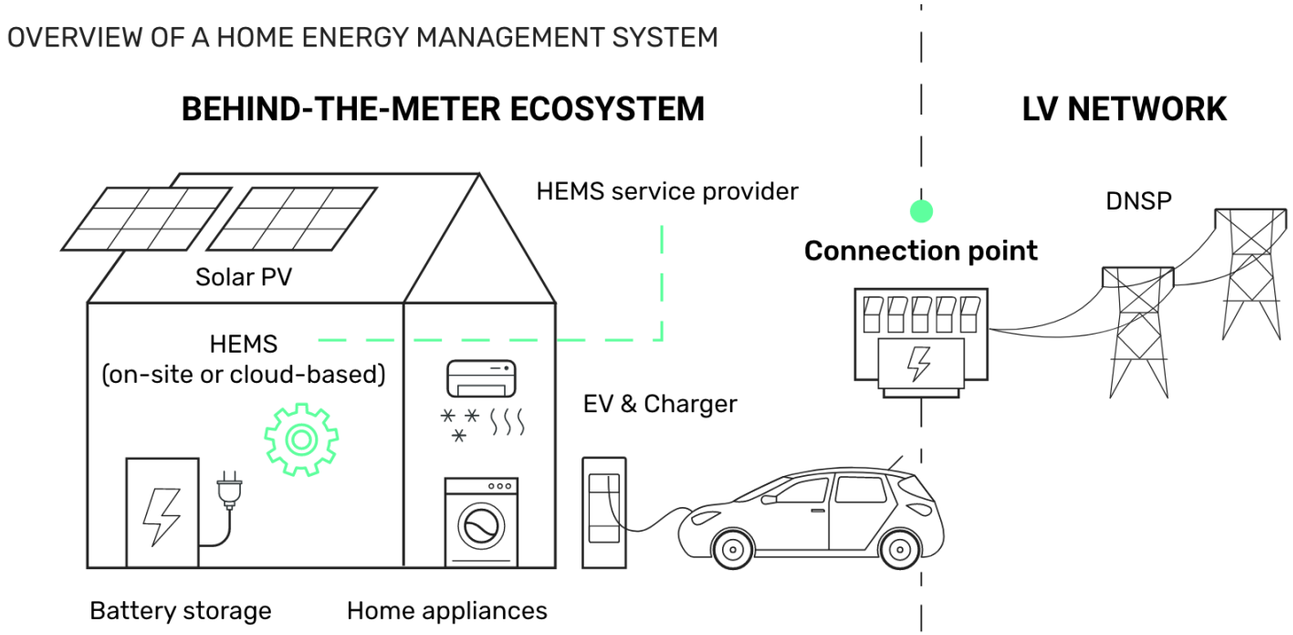


Figure 1: Overview of home energy management system (Strauli et al. 2022)

Four Layers of Interoperability

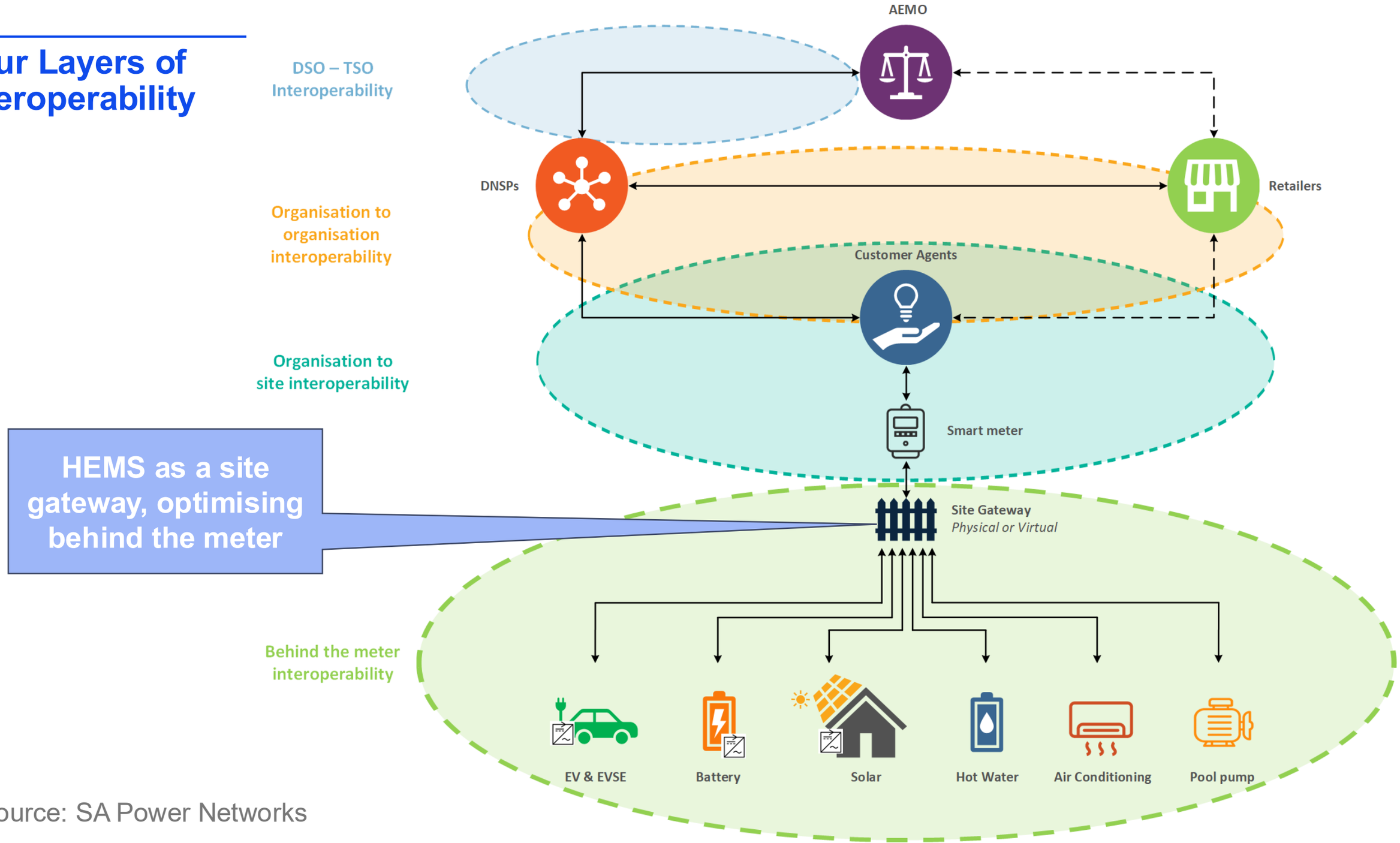


Image Source: SA Power Networks

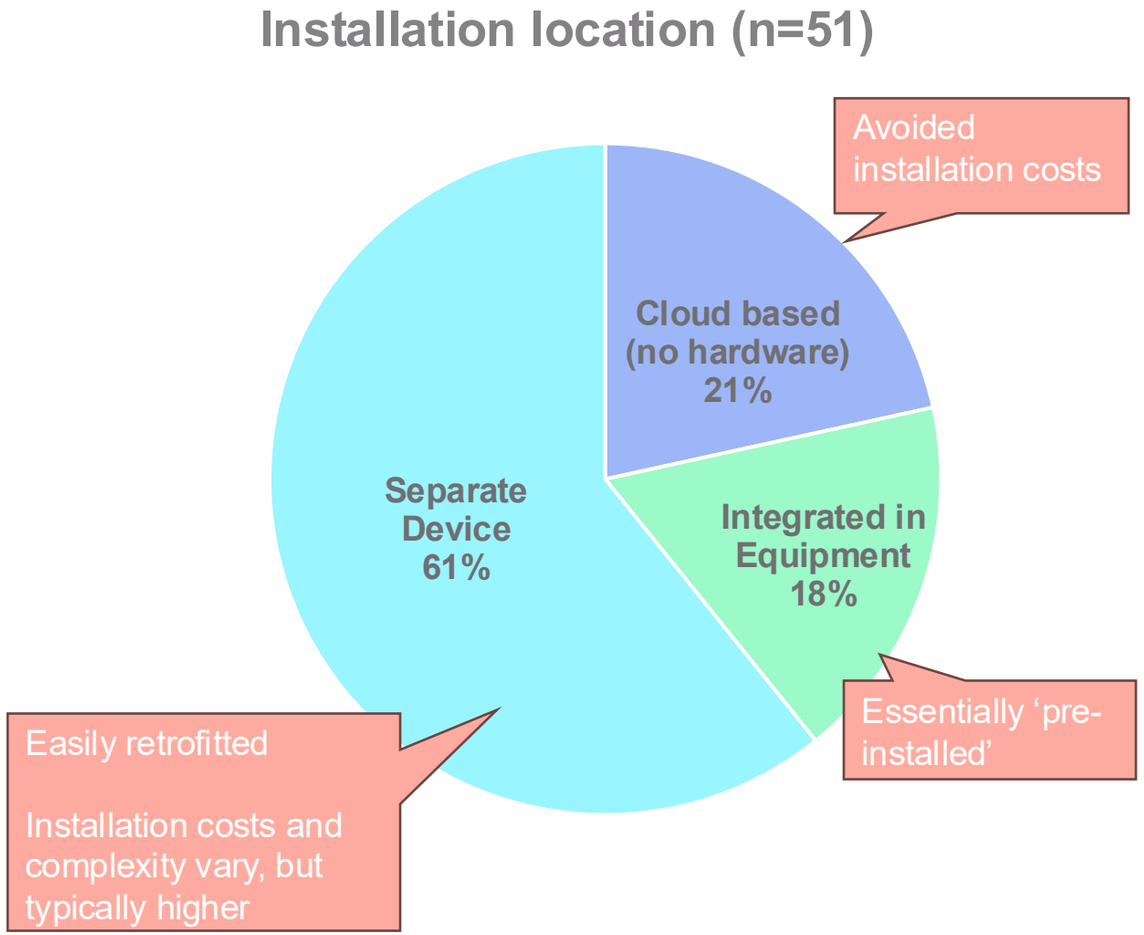
Global HEMS Market Scan

#	Company name	Product Overview	Market Data	Technical Capabilities	Communications
1	Village Energy (Voltello)				
2	Solahart (Combined Energy CET?)				
3	Combined Energy (CET)				
4	Catch Power				
5	GoodWe SEMS				
6	Clipsal Cortex				
7	SMA Australia				
8	SolarEdge Energy Hub				
9	Evergen				
10	FlexMeasures				
11	Octopus Energy				
12	AmpX				
13	Alpha ESS				
14	Intellihub				
15	Powertech Energy				
16	SwitchDin				
17	ABB Insite EMS				
18	Zeco energy				
19	Reposit Power				
20	369 Labs				
21	Home Assistant.io				
22	Growatt				
23	Savant				
24	Tesla				
25	Sonnen				
26	Emporia				
27	Samsung				
28	RTI				
29	Enphase				
30	1KOMMA5°				
31	E3/DC				
32	Ferroamp				
33	Huawei (Fusion Solar)				
34	Senec (EnBW)				
35	OVO Energy				
36	E.ON				
37	Siemens				
38	Iberdrola				
39	Bosch				
40	Panasonic (Japan)				
41	Alarm.com				
42	Swell Energy				
43	GEO				
44	Powerverse				
45	Volt Time				
46	Next Drive				
47	Honeywell International				
48	Vivint Smart Home Inc				
49	Ecobee				
50	GridX (Xenon)				
51	Schneider Home				

What type of devices are on the market – Where are they installed?

Based on scan of available products, not share of sales data

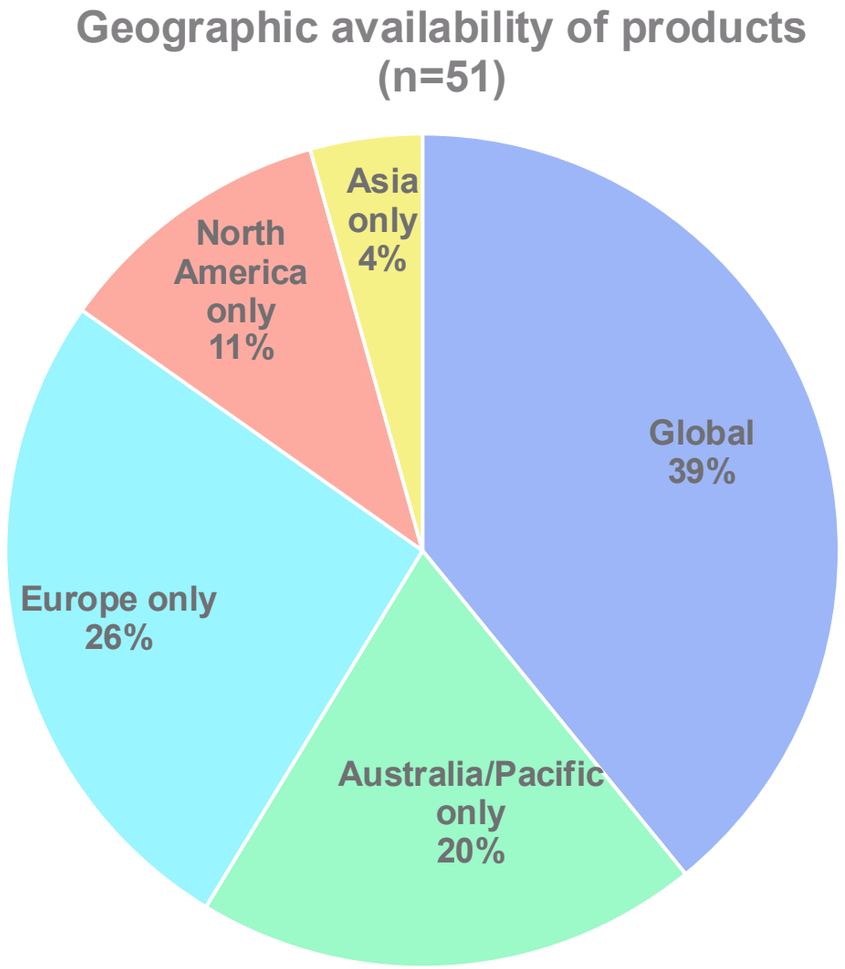
- The majority of HEMS are separate devices. Some products are integrated in smart meters, while others are integrated in solar/battery controllers or inverters.
- **Important implications for installation cost**
- Some separate plug & play devices or fully cloud-based HEMS avoid installation costs altogether.
- Integrated devices require electrician but already ‘paid for’.
- Separate requires dedicated electrician visit.
- Installation could increase total cost by factor of 4-5.



HEMS availability across markets

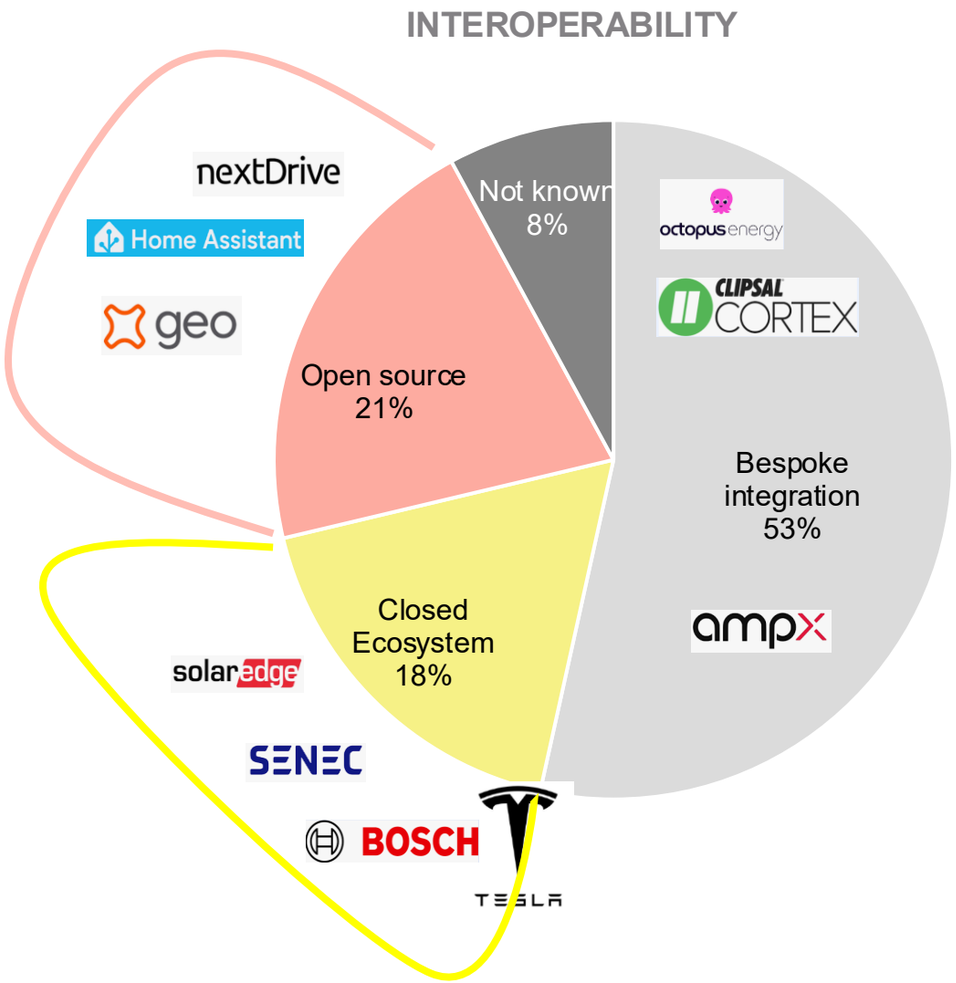
Based on scan of available products, not share of sales data

- Companies entering the HEMS space from a diversity of industries, for different reasons
  - market opportunity, product differentiation (e.g. solar) or customer acquisition/retention
- Majority of the researched products restricted to single region e.g. Europe, North America, or Australia only
- But 39% available globally (3 or more regions) – expect this to grow as industry consolidates over time
- **More global HEMS products → need for more global interoperability standards**



Interoperability approaches

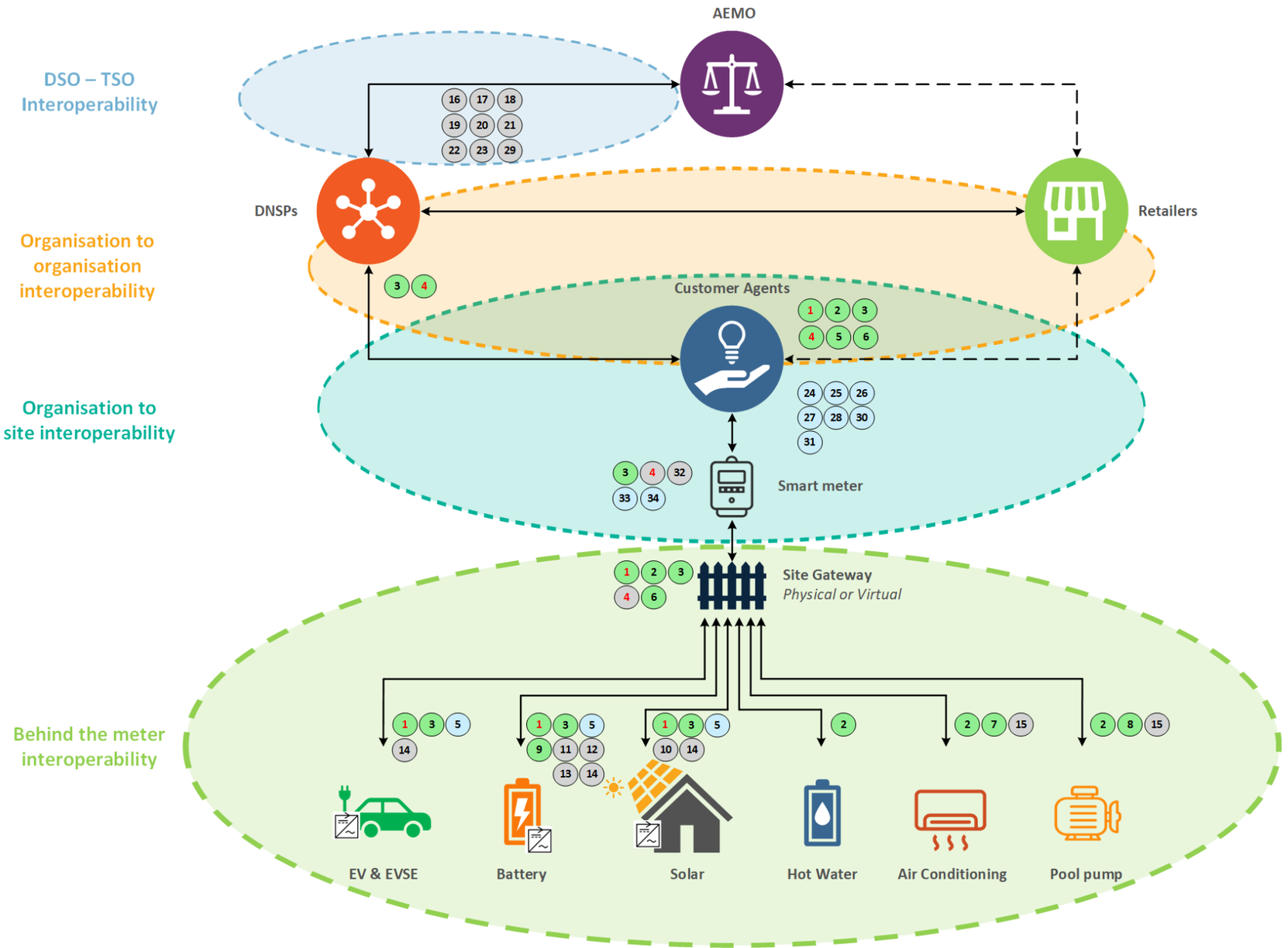
- Main approaches:
  - **Open standards** - specifically uses an open-source protocol e.g. Matter, Sunspec, Modbus
  - **Closed ecosystem** - only works with compatible products using a proprietary comms protocol (or limited functionality e.g. VPP only, not home optimisation (Tesla)) → Customer lock-in
  - **Bespoke integration** - no restriction on API usage (private protocol, but openly published), but requires specific work to design integration.
- Bespoke integration is dominant, but requires significant time and effort



BTM interoperability challenges in the field

- HEMS developer needs to code bespoke integrations for every brand (and potentially model) of connected equipment → Long project lead times.
- Retrofit installations (integrating with existing equipment) are particularly bespoke:
  - HEMS + one other appliance can take a whole day.
  - Commissioning takes time – up to 5 apps with different documentation required.
  - Still finding new permutations after 90 installations.
- High installation costs could make HEMS scaling challenging.

Mapping Standards for Interoperability (National level)



Key

- Core
- Supporting
- Adjacent

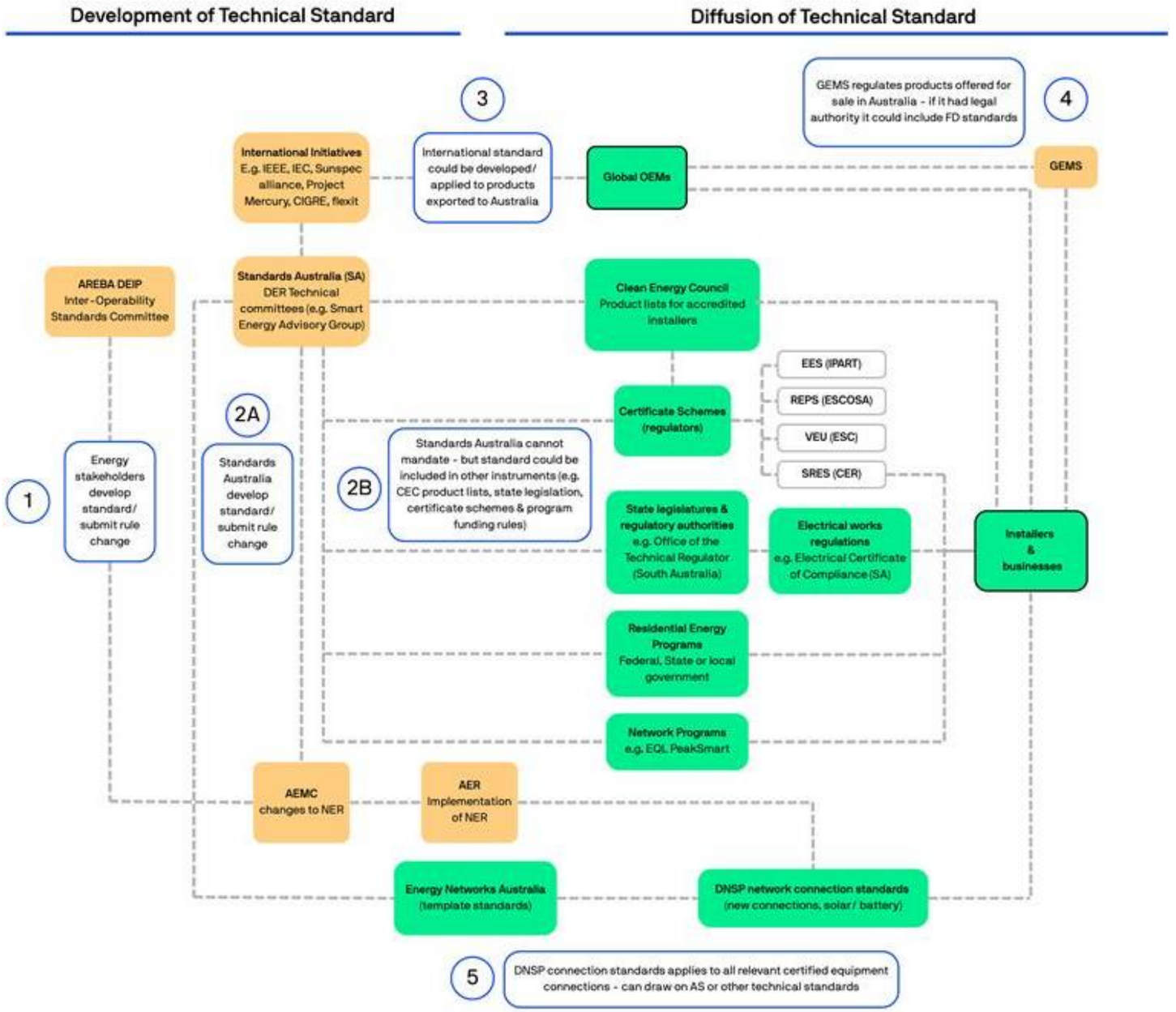
Text or numbers in red indicate a DRAFT standard, technical guideline, or initiative.

WORK IN PROGRESS

- **Lots of standards covering partial functionality** (comms, control, safety).
- **There is no 'standard to rule them all'.**
- Prominent standards are **emerging by connected technology.**

- **Pending work:** Which part of existing standards are useful, and where are the gaps?

Developing technical standards is only part of the picture



WORK IN PROGRESS

- **Multiple pathways** (6) through which an interoperability standard can be delivered.
- **GEMs** appears to be the most suitable mechanism/pathway.
- But probably needs **regulation**, **incentives** and reinforcement through **multiple pathways**.
- Effective engagement with **international OEMs** is needed.

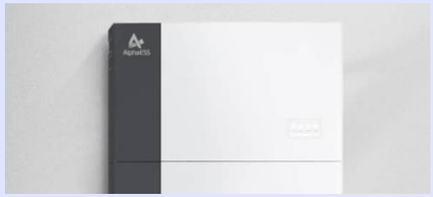
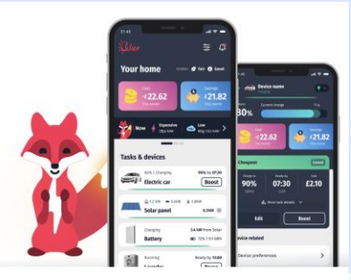
Thank you

Contact
Dr Ed Langham - Edward.Langham@uts.edu.au

HEMS Market Scan

Energy Masters Lessons Learned #1

HEMS case studies

	Village Energy (Voltello)	Intellihub	Alpha ESS	AmpX
Description				
Company background	Tech Company	Tech Company	PV/Storage Specialist	Tech Company
Installation type	Separate Device	Integrated in Equipment (smart meter)	Integrated in Equipment (Battery)	Cloud based (no hardware)
Type of control	Partial cloud	Partial cloud – Evergen partnership	Partial cloud	Cloud based (no hardware)
Availability	Australia only	Australia only	Global	Global
Consumer Energy Resource (CER) capabilities	Sophisticated	Orchestrated	Orchestrated for BESS	Basic
Load capabilities	Sophisticated with additional hardware	N/A	Orchestrated for Evs	Sophisticated
Sceptical overall HEMS control	Sophisticated	Orchestrated	Sophisticated	Basic
Highest stated overall HEMS control	Orchestrated	Orchestrated	Orchestrated	Sophisticated
Notes on classification	*Trialled third party control curtailing solar export at negative price*	*Only provides CER functionality*	*Orchestrated control for EV and BESS if connected to the AlphaESS batteries*	
Interoperability categorisation	Bespoke Integration	Bespoke integration	Open source for monitoring and closed ecosystem for sophisticated use of battery	Bespoke Integration