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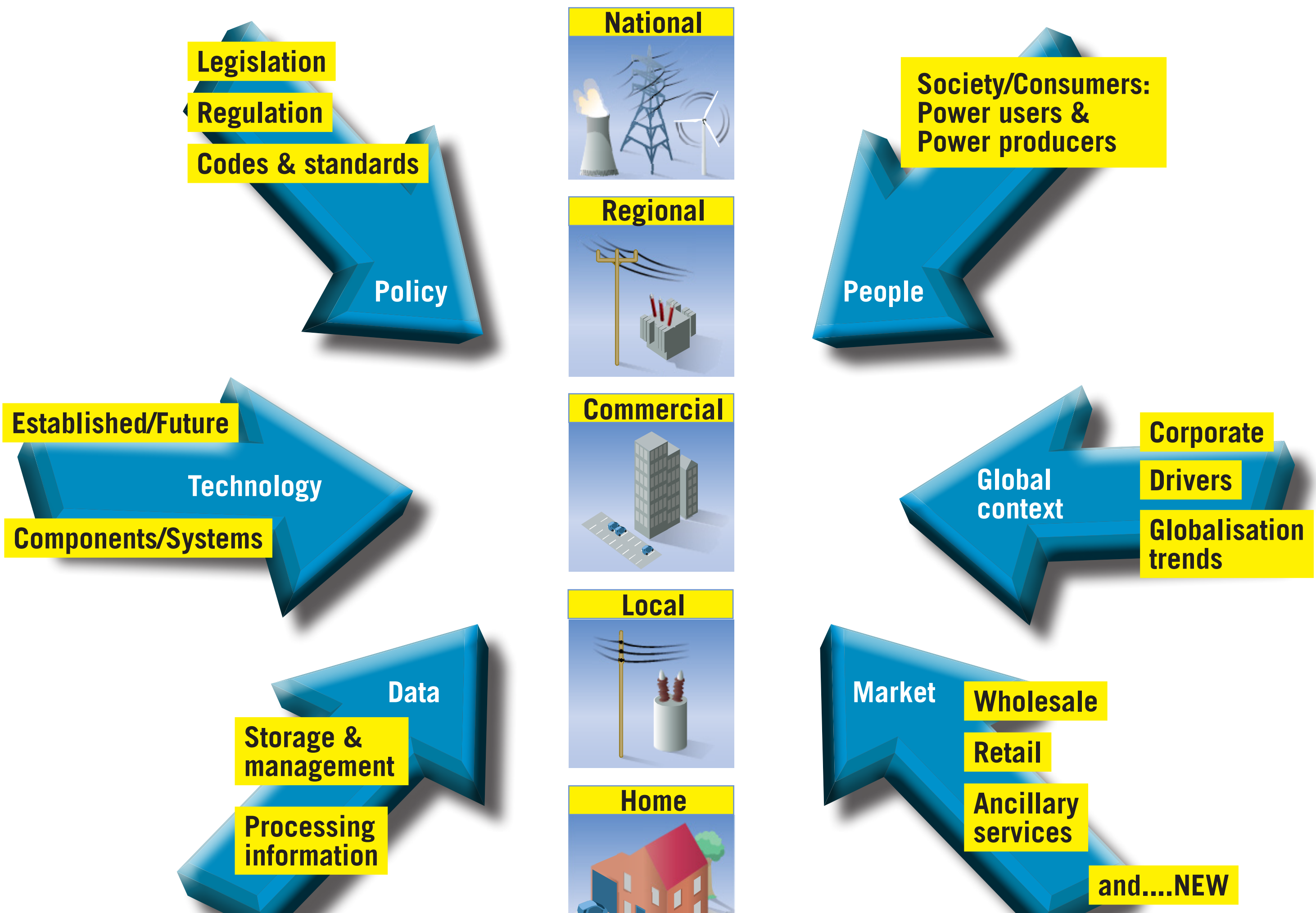
Smart Grids - The Wider Picture

A Briefing provided by the Institution of **Engineering and Technology**



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About This Briefing

The Institution of Engineering and Technology acts as a voice for the engineering and technology professions by providing independent, reliable and factual information to the public and policy makers. This Briefing aims to provide an accessible guide to current technologies and scientific facts of interest to the public.

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The Institution of Engineering and Technology

The Institution of Engineering and Technology (IET) is a global organisation, with over 150,000 members representing a vast range of engineering and technology fields. Our primary aims are to provide a global knowledge network promoting the exchange of ideas and enhance the positive role of science, engineering and technology between business, academia, governments and professional bodies; and to address challenges that face society in the future.

As engineering and technology become increasingly interdisciplinary, global and inclusive, the Institution of Engineering and Technology reflects that progression and welcomes involvement from, and communication between, all sectors of science, engineering and technology.

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Introduction

A **Smart Grid** will be needed in the UK from around 2020 onwards in order to operate the electricity network in a low carbon energy world in a manner that is secure, cost-effective and able to respond to new demands. The proposed levels of intermittent renewable generation and new higher capacity nuclear generation will need to be balanced by developments in demand side participation and energy storage. A smart grid will enable engineers to integrate demand management and distributed generation sources, achieve more efficient utilisation of existing infrastructure and consequently operate this effectively in conjunction with new large scale generation.

But what does this mean in practice? Engineers and policy makers planning for a Smart Grid can often be "divided by a common language". Even the words Smart and Grid can mean different things to different experts depending on the discipline in which they were originally trained and have experience.

In this Briefing, we keep words to a minimum in order to maximise its usefulness as a tool for reaching a **common understanding** of the challenges and goals ahead, allowing dialogue between different segments and sectors of the community.

The **Institution of Engineering and Technology** includes within its membership Professional Engineers in the fields of Energy, Transport, Communications and IT. Experts from these four disciplines are **working together** to understand what needs to be designed to build a smart grid capable of meeting the challenges of a low carbon future. The key is to view the entire system as offering a dynamic and flexible solution to addressing some of the most intractable contradictions that exist between the world of yesterday and the needs of tomorrow.

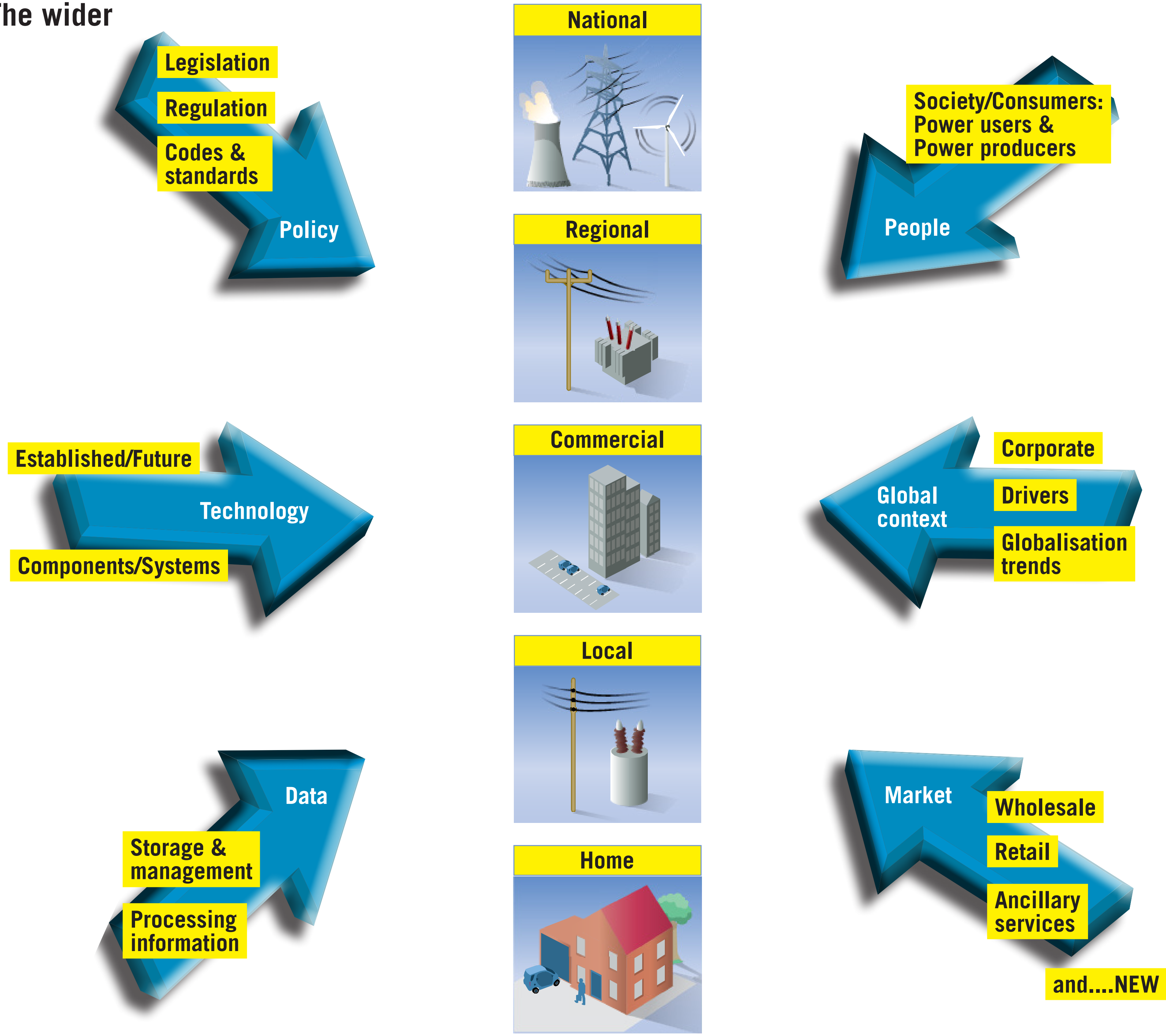
We make no apology for the first stage of our inter-disciplinary work on Smart Grids concentrating primarily on an **energy perspective** and more specifically the interface between the Grid and the home. While IT systems may typically have a life of ten to fifteen years and the communications industry goes through an entire new generation every three or four years, the physical assets of the **energy infrastructure** typically last for 40 years. Earlier replacement is both costly and highly disruptive for the public. A major investment programme is planned for the electricity network in the period up to 2020 and of course the grid can't be shut down in order to work on it. The electricity network has to be kept running 24 hours a day, 365 days of the year so major upgrading is a bit like re-building a jumbo jet while it is in flight.

It is worth noting that, as with many countries internationally, the UK's **Transmission Grid** already incorporates a high degree of "smartness". It manages two-way power flows, has good sensors, and utilises real time data and advanced processing. Bringing this degree of flexibility and interactive control to the lower voltage **Distribution Grids** that feed our homes and businesses is the challenge ahead for Smart Grids. Achieving this will be key to our low carbon future as it will provide the way to balance the grid on a minute by minute basis once we have large amounts of renewables in the UK energy mix and the extra demands of electric vehicles and heat pumps. Furthermore, there is still much opportunity to be taken in enhancing the interaction between Distribution and Transmission levels. Our existing Transmission philosophy still derives from a world of "command and control" rather than the emerging world of dynamic interaction between user and producer.

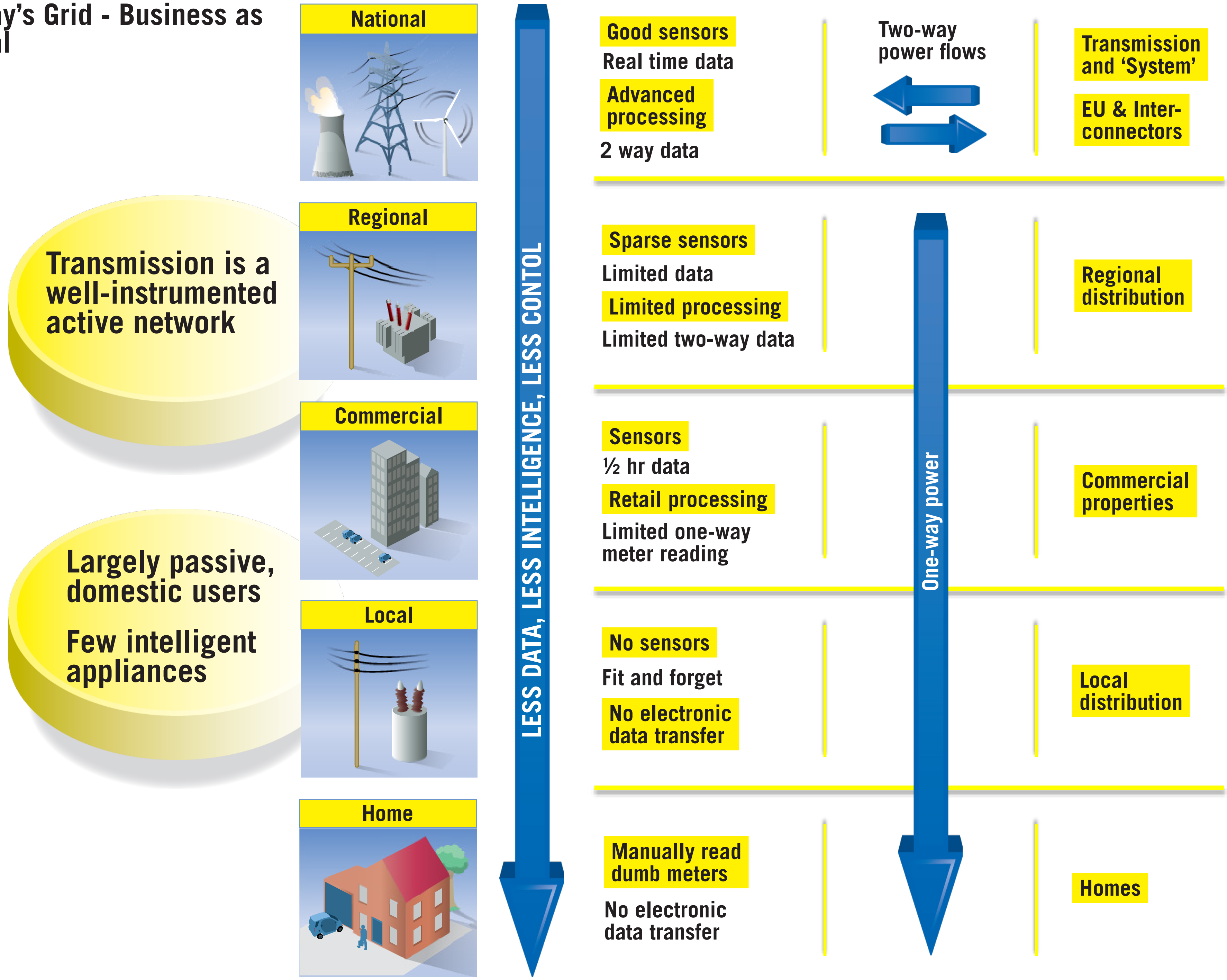
This is **work in progress** and The IET aims to expand the scope of this work to include the entire Smart Grid from user to producer and providers of new services.

The pages that follow serve as an **informed basis for discussion** as engineers from all disciplines come together with policy makers and the public to debate the issues and solve the technical and commercial challenges ahead.

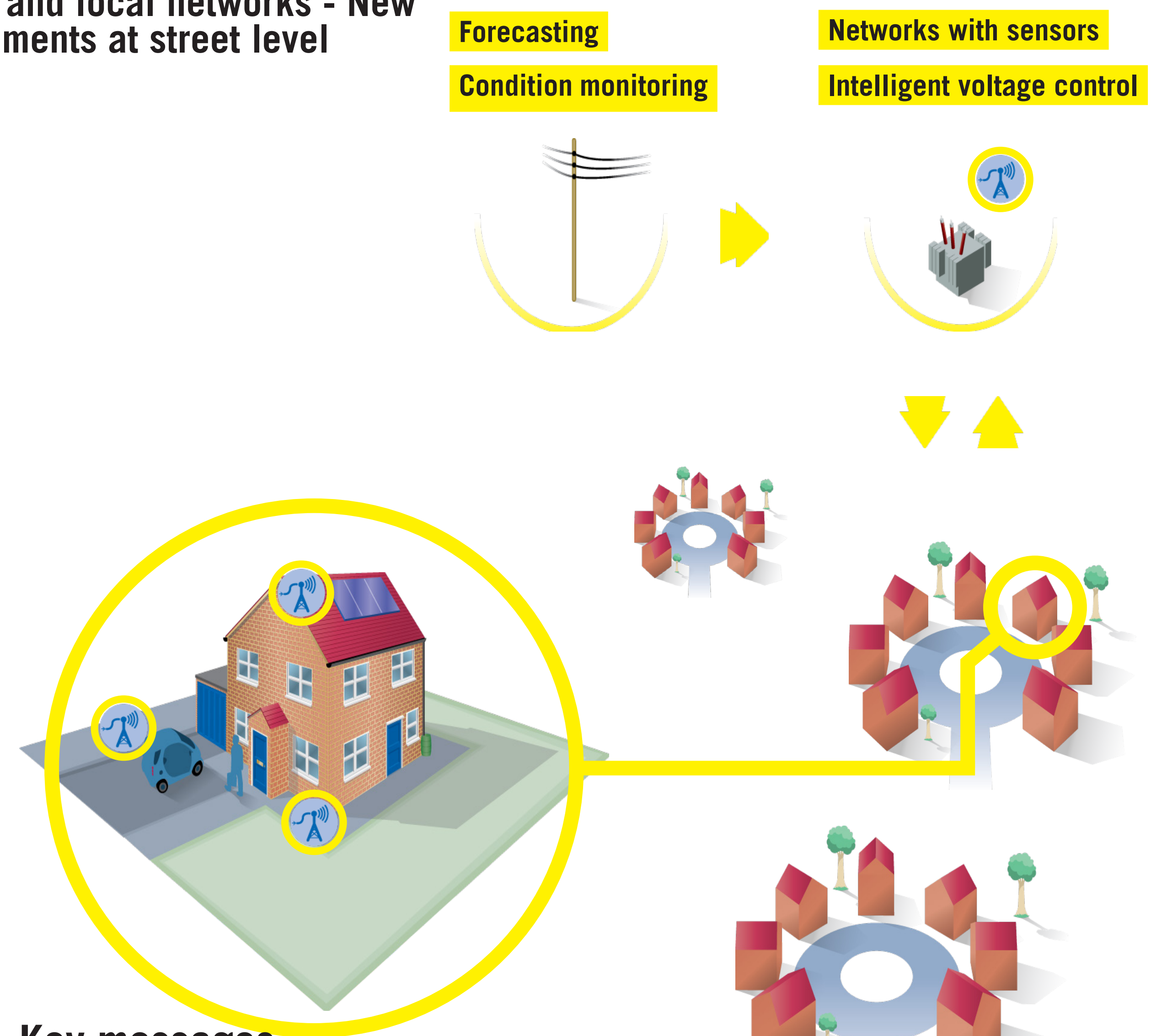
Smart Grids - The wider picture

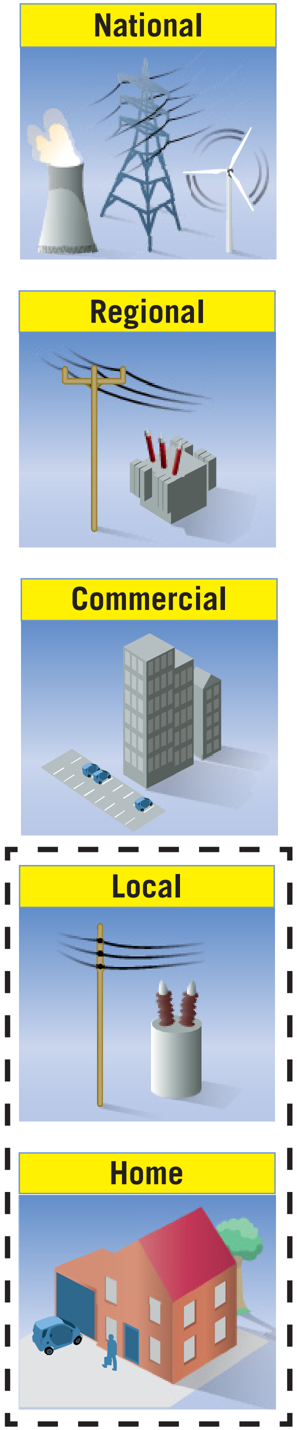


Today's Grid - Business as usual



Homes and local networks - New requirements at street level





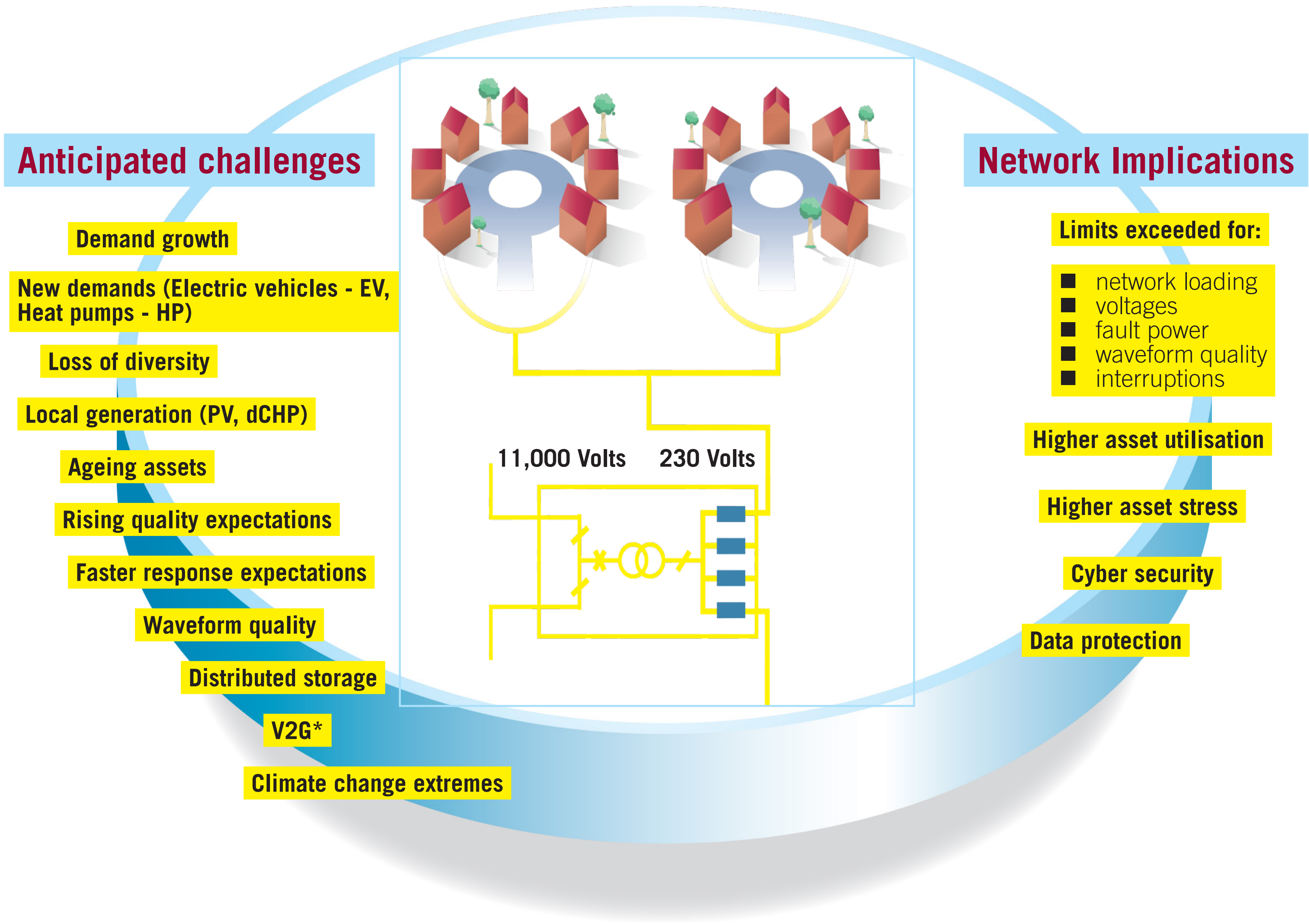
Key messages

Photo-voltaic panels (PV) can create two-way power flow

Electric vehicles (EVs) are a substantial new load - potential controllable charging load, and potential storage and power source

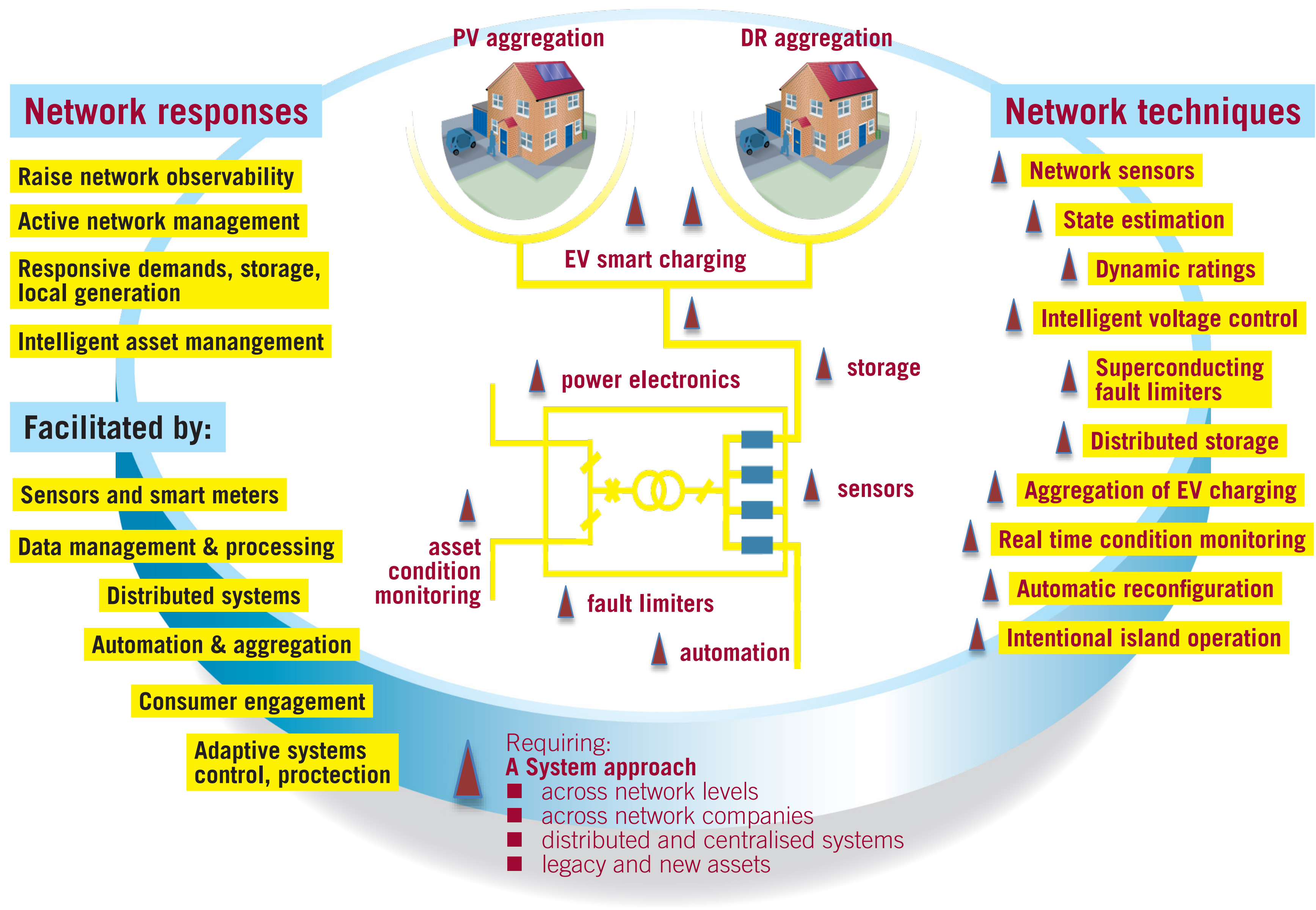
Requirement for sensors, communication and processing

Homes and local networks - Anticipated challenges

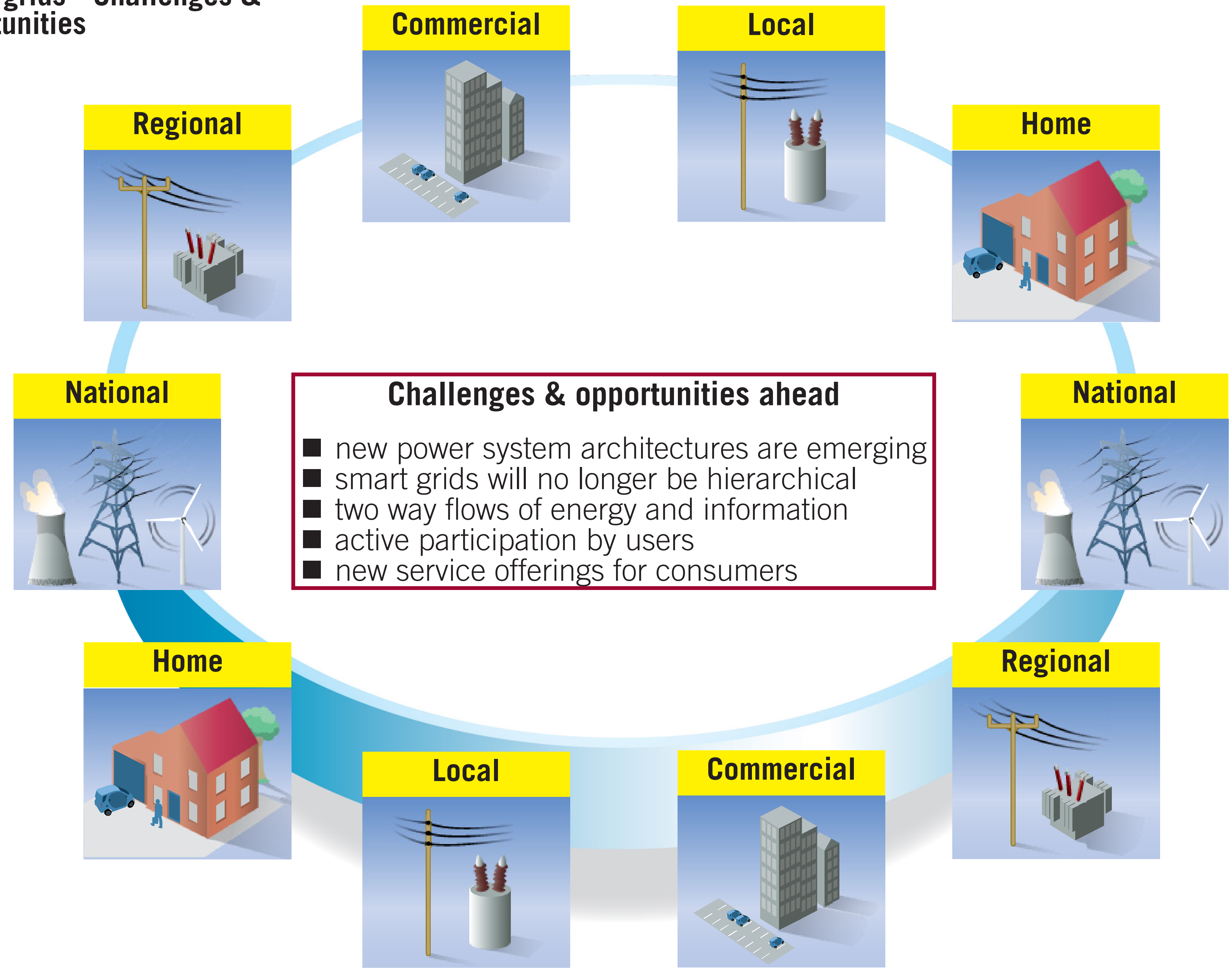


* V2G (vehicle to grid) is the controlled feed of electricity stored in a vehicle battery back into the local network at times of high demand.

Homes and local networks - Network responses



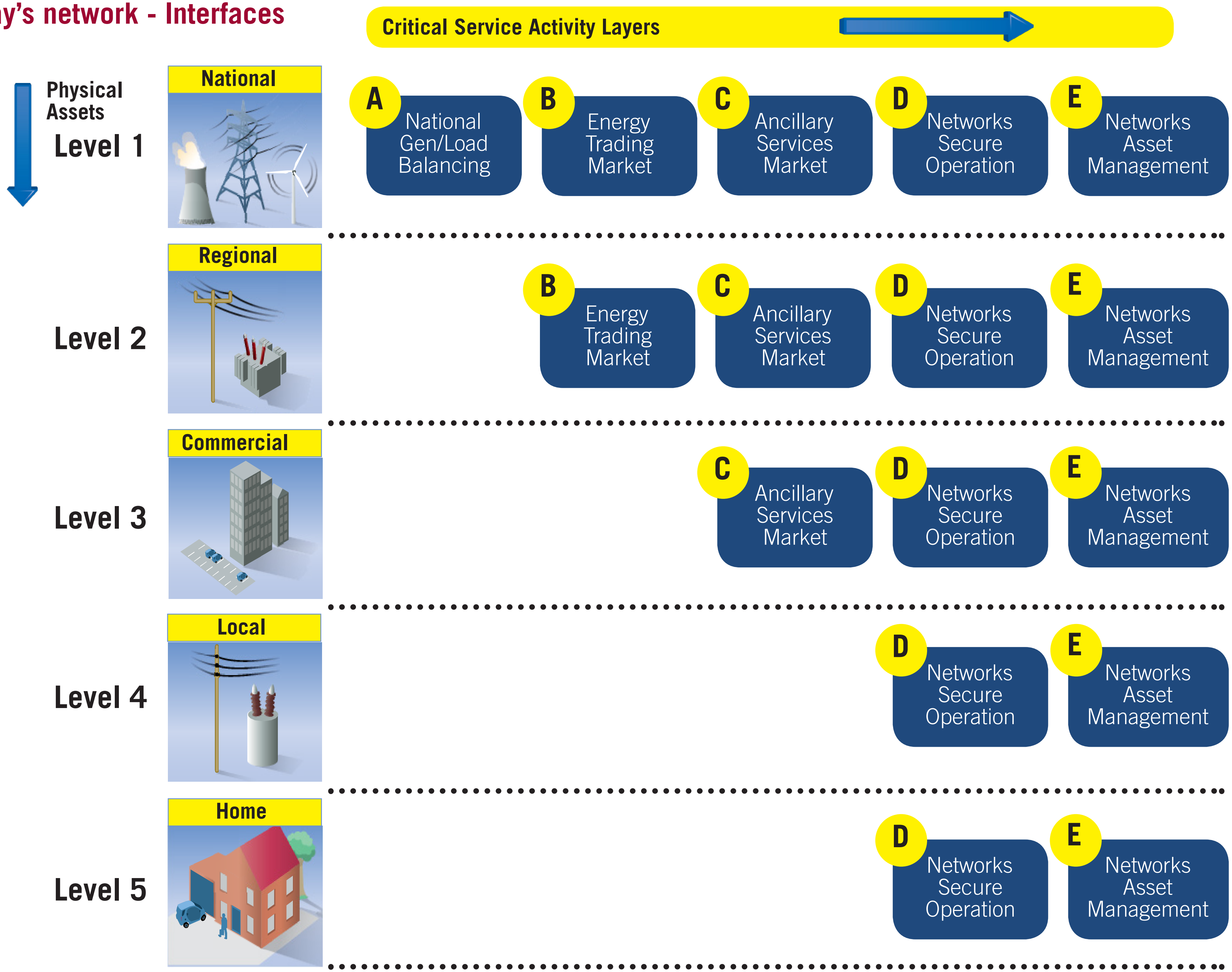
Smart grids - Challenges & opportunities



Challenges & opportunities ahead

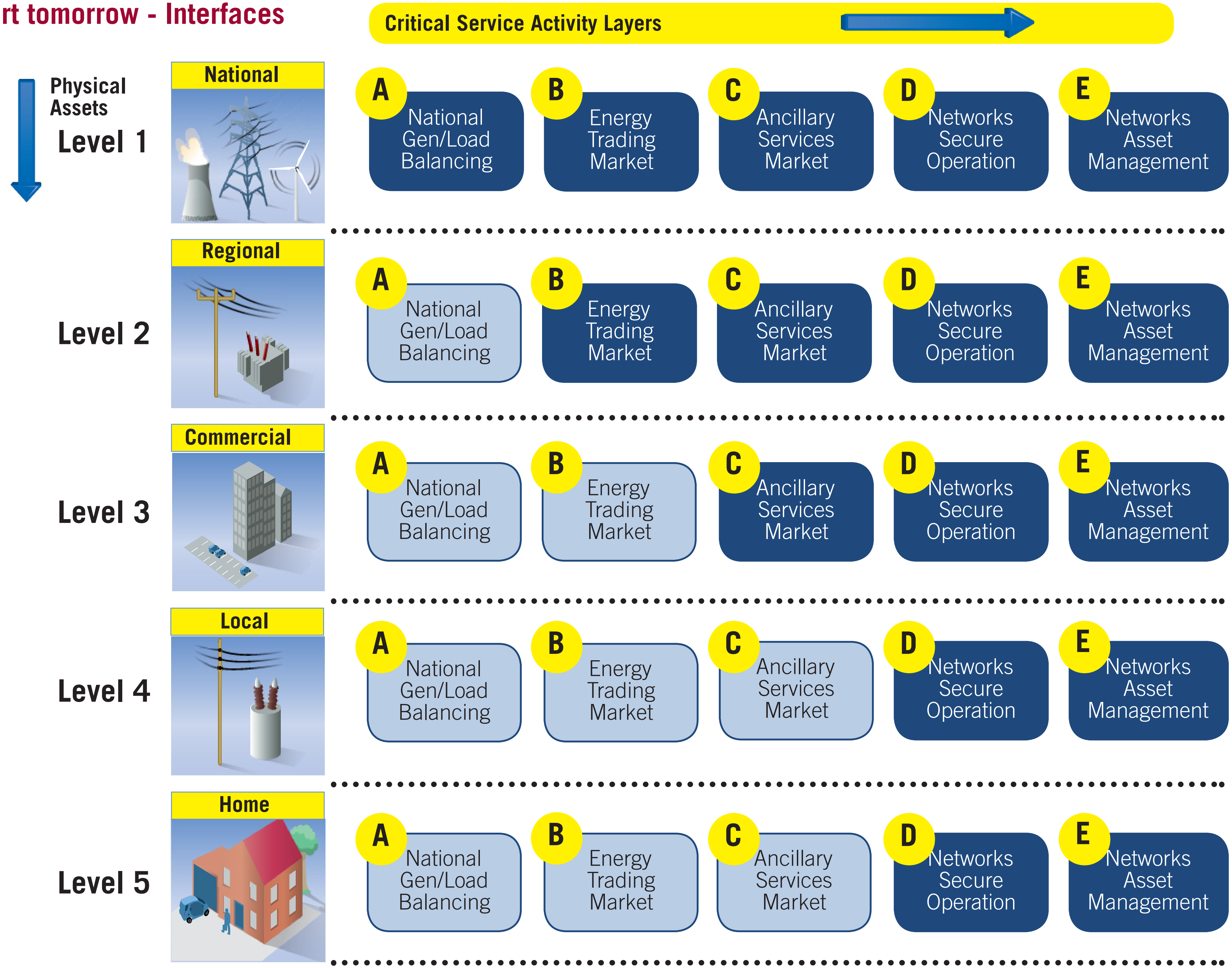
- new power system architectures are emerging
- smart grids will no longer be hierarchical
- two way flows of energy and information
- active participation by users
- new service offerings for consumers

Today's network - Interfaces



Consider: interfaces, interface standards existing & required, also external interfaces; data exchange requirements and permissions

Smart tomorrow - Interfaces



Consider: interfaces, standards, data exchange requirements and permissions

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