<< go to Part 3: Management and Methodology

BUILDING CONSTRUCTION
TECHNOLOGY ROADMAP

Part 4:

Results

PART 4:

Results

Roundtable results

The key **Ten Characteristics** of the dwellings of 2025 examined in roundtables 1 and 2 were:

1. Flexibility, modularity and materials
2. Services: water to and within the dwelling
3. Services: energy to and within the dwelling
4. Communications to and within the dwelling
5. Security, safety and health
6. User-friendliness, comfort and aesthetics
7. Home operations base
8. Entertainment
9. Smart services, appliances and fittings
10. Maintenance management.

The results are listed in three-column tables on pages 12 to 31. The first column of each table lists the identified **trends**, the second column lists the **issues** associated with each trend, and the third column lists the **enabling technologies** to address the trends.

The **trends** were ranked by the project team in terms of market opportunity, with the market divided into two segments – the existing stock of 7.9 million homes and the 3 million new homes it is assumed will be built in the next 20 years. The ranking consisted of the aggregate market opportunity of the existing stock of homes plus new homes. Those trends applicable only to new homes were ranked low or low-moderate and those trends with a market opportunity in a large percentage of both existing and new homes were ranked high or high-moderate.

The **enabling technologies** were ranked according to their availability. Those technologies that already exist were ranked high, those seen as existing but needing convergence were ranked moderate-high, while those still at the R & D stage were ranked low or low-moderate.

These rankings are plotted on a series of matrices presented on pages 13 to 31 to allow the reader to compare the various trends and enabling technologies and to identify technologies of interest.

Interpretation of matrices

Vertical Axis

The vertical axis represents the estimated 10.9 million total stock (market) of dwellings in Australia in the year 2025. This consists of existing stock of 7.9 million in 2004 plus the estimated 3 million dwellings to be built in the next 20 years.

The market opportunity for a specific **trend** may be in either new dwellings only or in new plus retrofit of the existing stock. The vertical axis has been ranked into five categories, namely low, low-moderate, moderate, moderate-high and high.

A trend that is likely to occur in 100 per cent of the projected 3 million new dwellings but not at all in existing dwellings has been ranked as low-moderate. A trend that is likely to occur in 50 per cent (1.5 million) of new homes, and in 80 per cent (6.3 million) of existing homes (e.g. a total of 7.8 million homes) has been ranked high-moderate.

Horizontal Axis

The horizontal axis represents the panel's confidence in the **enabling technology** fit or development, ranked as low, low-moderate, moderate, moderate-high and high. In some instances the technology/ies may already exist in the form required, would be considered mature and therefore ranked as high.

If a number of existing technologies exist, but need to be assimilated into the one service or product, they have been rated moderate-high. For example, (see Matrix 2: Water Services, Enabling Technology, item 4) small household packaged grey water treatment plants with auto dosing do not currently exist commercially. However the technologies to make such a commercial packaged plant do exist and need only to be converged. Such a product is therefore rated moderate-high. Another example is the packaged mini gas turbine, listed as Enabling Technology 3 in the Services Energy Matrix 3. Whilst these units exist at a large commercial level, the level of confidence in their technological development or fit for domestic purposes is low.

Data Points

Most data enabling technologies are plotted as hollow circles (1). When an enabling technology is particularly interesting to the Copper Industry, it is plotted as a solid circle (1). When two or more enabling technologies share the same market size and availability, they are plotted as a square (A) with the individual technologies sharing that location given in a key below the matrix.

CHARACTERISTIC 1:

Flexibility, modularity & materials

This relates to the shell, materials and design elements of the structure. It looks at flexibility of layout and modularisation of components, to allow for inexpensive reconfiguration of rooms in the future. It addresses onsite versus close tolerance factory manufacture of either the whole structure or modules. Marketing benefits can accrue to the owner/occupier.

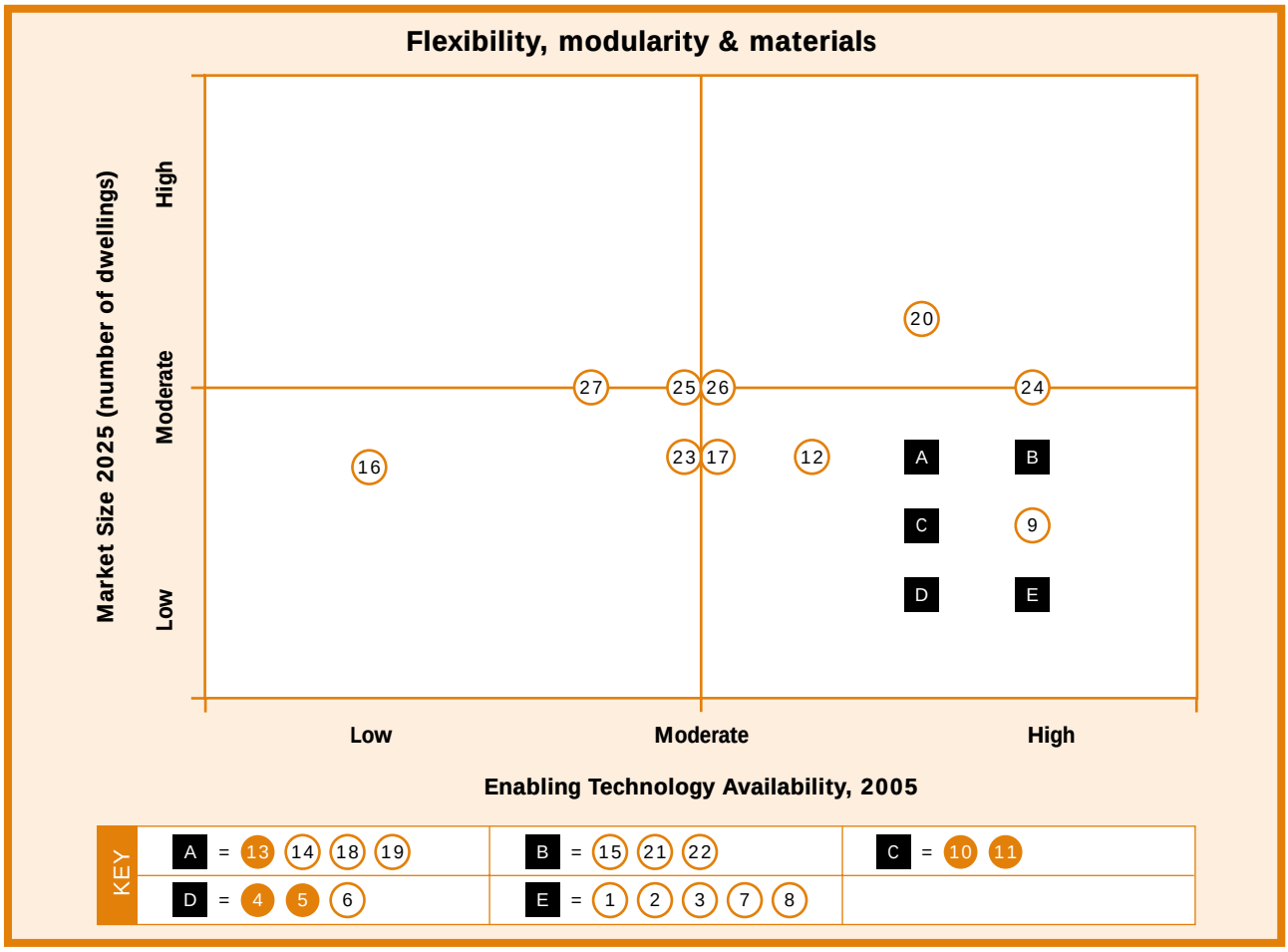
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Prefab whole structure • Prefab internal walls • Relocatable modular internal walls	• Lack of skilled tradesmen • High on-site costs • Time consuming BCA approval process and regulations for joints, services and systems • Need to deskill site installations and increase speed of construction • Internal layout needs to change simply as family and aging requirements change • Internal walls designed for recycling	1. Design assisted by artificial intelligence – virtual walkthrough using CAD for marketing 2. Fast factory manufacture using CAD/CAM and CNC close tolerances 3. Data collection forms basis of home instruction manual 4. Wall and smart service loom connectors across joints* 5. Vertical and horizontal service ducts* 6. Develop flat wire cable looms to fit skirting/ducts, aiding future expansion 7. Light weight non-load bearing partition type walls readily relocatable 8. Levelling screws, floor and ceiling cover strips, acoustics approximately 40dba
• Prefab service modules, bathroom and kitchen	• Fast installation and inclusion of 3rd pipe	9. Factory manufactured complete unit or kit 10. Complete with 3rd pipe, smart wiring etc* 11. Ditto kitchens including plumbing and smart wiring*
• Sensors embedded in walls • Service looms embedded in ducts or skirtings	• Intelligent active environmental and security control systems • High resolution information • Convergence of media via digitisation • Flexible access to power and communications	12. Wireless micro sensors for control of ventilation, temperature, lighting and energy usage, water quality (10-15 years from market as of 2004) 13. Flat wire looms and multi-capacity ducts/skirtings*
• Smart windows	• Thermal, optical and acoustic control	14. Integrated photovoltaics 15. Films incorporating nano particles (e.g. ZnO, Au) for spectral selectivity, giving reflectivity and thermal control 16. Holographic/imaging projection 17. Organic Light Emitting Diode (OLED) embedded in conducting polymer layer in laminated windows 18. Switchable between transparent and opaque (e.g. SPD smart glass) 19. Integrally able to communicate to central control
• Surface coatings	• Self cleaning • Stain and mould resistance • Corrosion inhibition • Friction modification • Optical control of surfaces	20. Nano coatings, eg TiO2 (photocatalytic, hydrophilic), Si-based (lotus effect, superhydrophobic), oliophobic
• Ducted sunlight	• Reduce energy consumption and improve ambience	21. Polymer fibre optics for piping light 22. Skylights using smart window technology adapted to polymers 23. LEDs as alternative to incandescent and fluorescent light sources
• Textured finishes away from natural brick	• Widens aesthetic possibilities • Lack of bricklaying skills	24. Pressed, roll formed surfaces/products Cementitious and new coatings
• Insulation	• Energy reduction • Improved temperature control	25. Smart windows, improved thermal properties, R values of shell of structure 26. New insulation materials, e.g. aerogels
• Recyclable materials	• Reduce waste	27 Develop materials that can be split into components for easy recycling

* of particular interest to the Copper Industry

Potential industry participants

- Electrical, electronic hardware designers and suppliers
- Building materials suppliers and installers
- Plumbing fixtures manufacturers
- Fenestration/window systems suppliers
- Water heating manufacturers and services
- Computer hardware and software suppliers
- Coating suppliers/installers
- Maintenance and service contractors
- Instruction manual writers and software suppliers
- Plastic and aluminium extrusion suppliers
- Materials and photonics researchers

MATRIX 1



Sample interpretations

Item 9 – Factory manufactured bathrooms.

Technology availability:	Now
Market potential:	Low-moderate
Potential industry participants:	Building materials, electrical and plumbing manufacturers and installers.

Item 13 – Flat wire (ribbon) looms and multi-capacity slim ducts and/or skirting.

Technology availability:	High-moderate
Market potential:	Moderate-low
Potential industry participants:	Electric cable manufacturers and plastic and aluminium extrusion suppliers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 2:

Services: Water to & within the dwelling

The sustainability of water is addressed by way of alternative supplies to, and uses in, the dwelling and surrounds. Education of occupiers in relation to cost and volume of water being consumed at any time is addressed.

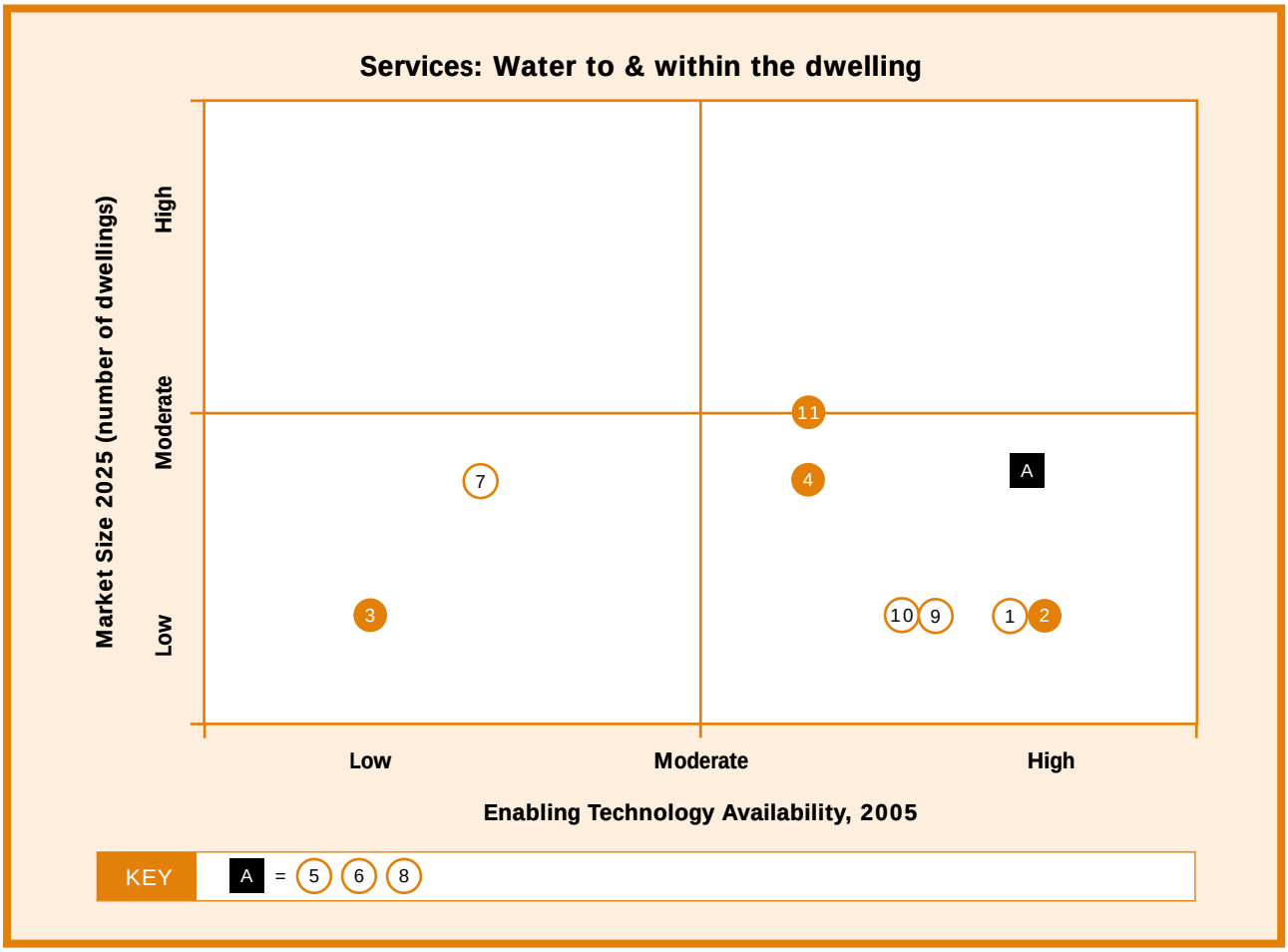
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Replace potable water with treated grey water for flushing, irrigating, car washing and fire protection. New suburbs or retrofit old	• Water conservation and sustainability • Use of waste water including shower, dishwasher, washing machine	1. Authorities' sewage treatment plant as part of new development/suburb 2. All homes fitted with 3rd pipe, leak proof lines and connectors* 3. Coating (nano?) to identify 3rd copper pipe*
• Replace potable water with treated grey water for flushing, irrigating, car washing, fire protection. Gather, store, treat and reticulate. New and retrofit individual homes	• Water conservation and sustainability • Use of waste products including shower, dishwasher, washing machine	4. On-site collection tank with packaged treatment and dosing capability* 5. Collection line, pump and piping to suit 6. Leak proof joints 7. Use of multifunctional nanoporous filtration for removal of chemical and biological impurities in water
• Collect site storm water and reticulate as above. New and retrofit	• Conservation of rainfall	8. Collection tank, pump and pipe work to suit
• Water meters that give real time usage and cost	• Education of public on real usage and costs	9. Remote gauge clearly visible in the house. Includes cost information 10. Instantaneous and cumulative read out
• Third pipe in new homes	• Conservation	11. Water collection and treatment as above for recycling*

* of particular interest to the Copper Industry

Potential industry participants

- Sewage authorities
- Light engineering
- Plumbing manufacturers and suppliers
- Plumbers/installation companies
- Chemical dosing companies
- Electrical/electronic gauge and equipment manufacturers
- Water chemical and biological filter companies

MATRIX 2



Sample interpretations

Item 4 – On-site packaged grey water collection and dosing system.

Technology availability:	Moderate-high
Market potential:	Moderate-low
Potential industry participants:	All of those listed above.

Item 7 – Nanoporous filtration for removal of chemical and biological impurities.

Technology availability:	Low-moderate
Market potential:	Moderate-low
Potential industry participants:	Water filtration companies and R&D groups.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 3:

Services: Energy to & within the dwelling

Electricity consumption per user has decreased in recent years but the peak usage has continued to increase. Electricity and alternate energy sources are examined for both sustainability and reduction of peak mains electricity demand. Education of occupiers in relation to cost and quantity of electricity being consumed instantaneously and cumulatively is addressed.

TRENDS	ISSUES	ENABLING TECHNOLOGY
• Solar energy	• Renewable to reduce greenhouse gases. Energy harnessing	1. Photovoltaic (including semi-transparent) and storage (battery) development
• Solar heating	• Renewable to reduce greenhouse gases. Energy harnessing	2. Solar thermal energy storage system* 3. Solar selective thin films for enhanced heat capture 4. Insulation materials 5. Paints with counter-intuitive thermal properties, e.g. warm whites & cool blacks
• Individual or community gas-powered generation	• Reduce reliance on mains supply electricity • Reduce peak electricity demand • Feed surplus power back into the grid • Utilise waste heat	6. Packaged mini gas turbines* 7. Backward running meter when supplying the grid 8. High efficiency gas fired appliances that condense the combustion gas to use the latent heat of vaporisation to heat water; e.g. water heaters, hot air furnaces etc* 9. Heat pumps 10. Integration with smart house OS[1] – regulation of supply/storage locally
• All houses fitted to reticulated gas in new suburbs. Retrofit suitable suburbs	• Reduce electricity demand • Government control of electricity distribution • More thermally efficient • Reduction of greenhouse gases	11. Gas pipe reticulation in each house* 12. Bottled gas short-term solution
• Back up power	• Provide redundant capacity to gain access to computer home in case of power failure	13. Battery back-up, capacitor or super-cap or mini-generator required to run current technology computers in case of power failure
• Gas heating, water and home. Gas cooking	• Instantaneous, efficient and reduces electricity peak demand	14. Reticulation as above
• Real-time and cumulative power metering and costs	• Education of public in instantaneous usage and costs • Access to cheapest power	15. Meter to read instantaneous usage and cost as well as cumulative. Similar dial suitable for visibly mounting next to water meter dial (instrument cluster)
• 12 volt bus	• Reduce number of appliance transformers	16. Solid or cable to allow appliances to direct connect*
• Smart wiring	• Provide flexibility of power and communications hook-up in any room	17. Thin flat wire ribbons to fit slim skirting multi-wire ducting* 18. Develop suitable connectors*
• Ducted cabling and connectivity throughout – skirting and verticals	• Ease of connection in any room	19. Slim architectural cable carrying skirting & mid height ducts. Suitable connectivity*
• Single cables for power and data	• Reduce number of cables	20. Develop for high speed data as well as power
• Underground power reticulation	• Improve street scape and safety	21. Appropriate trenching and ducts
• Embedded technology	• Smart materials • Need to monitor many modalities • Need to crash proof house OS • Security (post 9/11)	22. Embedded sensors and devices to provide comfort security, lighting/energy control with instantaneous readout of energy and water usage and cost. Micro & nano sensors 23. Autonomous networks 24. Micro wireless communication between embedded devices 25. Energy scavenging from environment, e.g. acoustic 26. House OS that optimises dynamic energy profile of building in real time

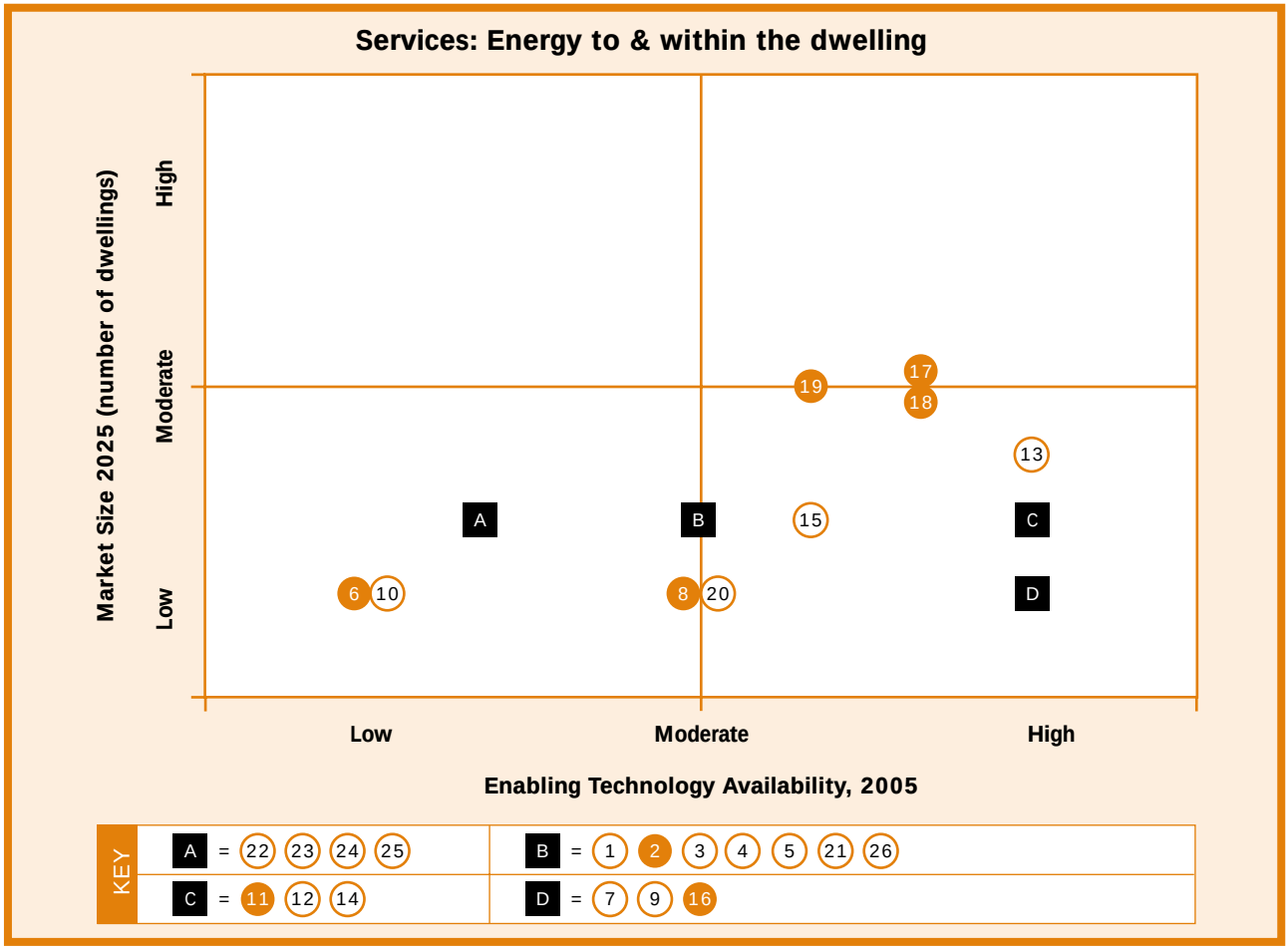
[1] Operating System

* of particular interest to the Copper Industry

Potential industry participants

- Solar panel systems manufacturers
- Light engineering/heat exchangers
- Insulation suppliers
- Gas distributors and installation companies
- Battery manufacturers
- Electrical/electronic manufacturers and equipment suppliers
- Electric cable manufacturers
- Nanotech R & D groups
- Aluminium and plastic extrusion companies

MATRIX 3



Sample interpretations

Item 4 – Heat banks and water condensors.

Technology availability:	Moderate
Market potential:	Low-moderate
Potential industry participants:	Solar panel manufacturers and light engineering companies.

Item 18 –
Ribbon power/integral communication cables to fit slimline ducting or skirting and to improve smart wiring.

Technology availability:	High-moderate
Market potential:	Moderate
Potential industry participants:	Cable manufacturers and extrusion or skirting companies; electrical installers; service engineers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 4:

Communications to & within the dwelling

Rapid changes in communications technology in this area have taken place in the past 20 years. The future holds the same promise.

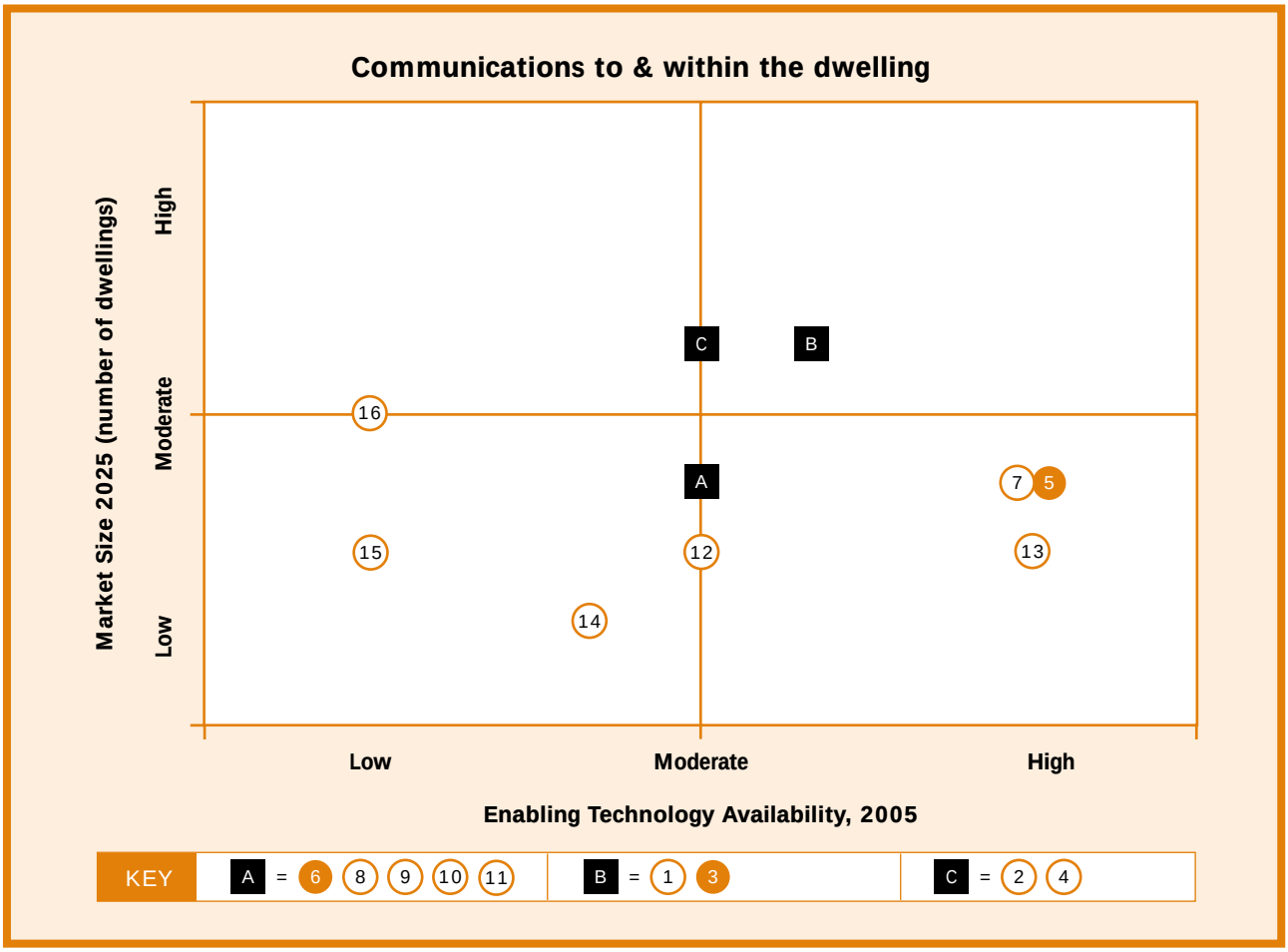
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Broadband to each dwelling	• Internet all-pervasive with continued rapid technology changes • Facilitating retrofit to existing dwellings	1. Self-installable broadband and digital services 2. Ultra high bandwidth wireless 3. Ribbon wires and connectivity carried in slimline skirting ducting* 4. Optical fibre included in the ribbon or ducting
• Cabling to each room	• Flexibility to connect in any room	5. Connectivity*
• Wireless, fibre optic	• Ease of maintenance (wireless) • Need for increasing bandwidth • Progress being made in these technologies • Decrease in number of dead spots	6. Inter-connectivity between wire cables/ribbons and fibre optics and wireless* 7. Computer-operated control system 8. House OS 9. Increase in wireless bandwidth
• Easy interlinks with above systems	• A mixture of technologies will accrue	10. Connectivity between wireless and appliances 11. Universal or smart protocols
• Digitisation of all forms of information	• Drives/assists in convergence • Once all information, communication and entertainment is digital need only one physical infrastucture to deliver (e.g. a screen that will allow video, video phone, and computer GUI)	12. Seamless technology to deliver data 13. All forms of IT and display technology
• Self-diagnosis of problems	• Difficulty of arranging repair technicians	14. Automatic repair systems
• Embedded technology	• Need to monitor and control more modalities at higher spatial and temporal resolution • Need for crash-proof systems • Need for systems to be able to make decisions	15. As for Characteristic 3 (22-25) 16. Artificial intelligence used in house OS

* of particular interest to the Copper Industry

Potential industry participants

- Major telcos
- Electrical and electronic suppliers
- Electrical/electronic installers
- Power and communication cable suppliers/optical fibre and wireless suppliers
- R & D nanotech sensors/minicomputers
- Aluminium and plastic extrusion companies

MATRIX 4



Sample interpretations

Item 6 – Interconnectivity between hard wire and fibre optic cables.

Technology availability:	Moderate
Market potential:	Moderate-low
Potential industry participants:	Electrical/electronics manufacturers and designers.

Item 10 – Connectivity between wireless and appliances.

Technology availability:	Moderate
Market potential:	Moderate-low
Potential industry participants:	Appliance manufacturers (industry body to agree common protocols).

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 5:

Security, safety & health

The 70-to-84 age group will double in number to 3.1 million by 2025. The 85+ age group will treble to 0.8 million. Meanwhile there is the perception, if not fact, that the country is becoming less safe and the Internet less secure.

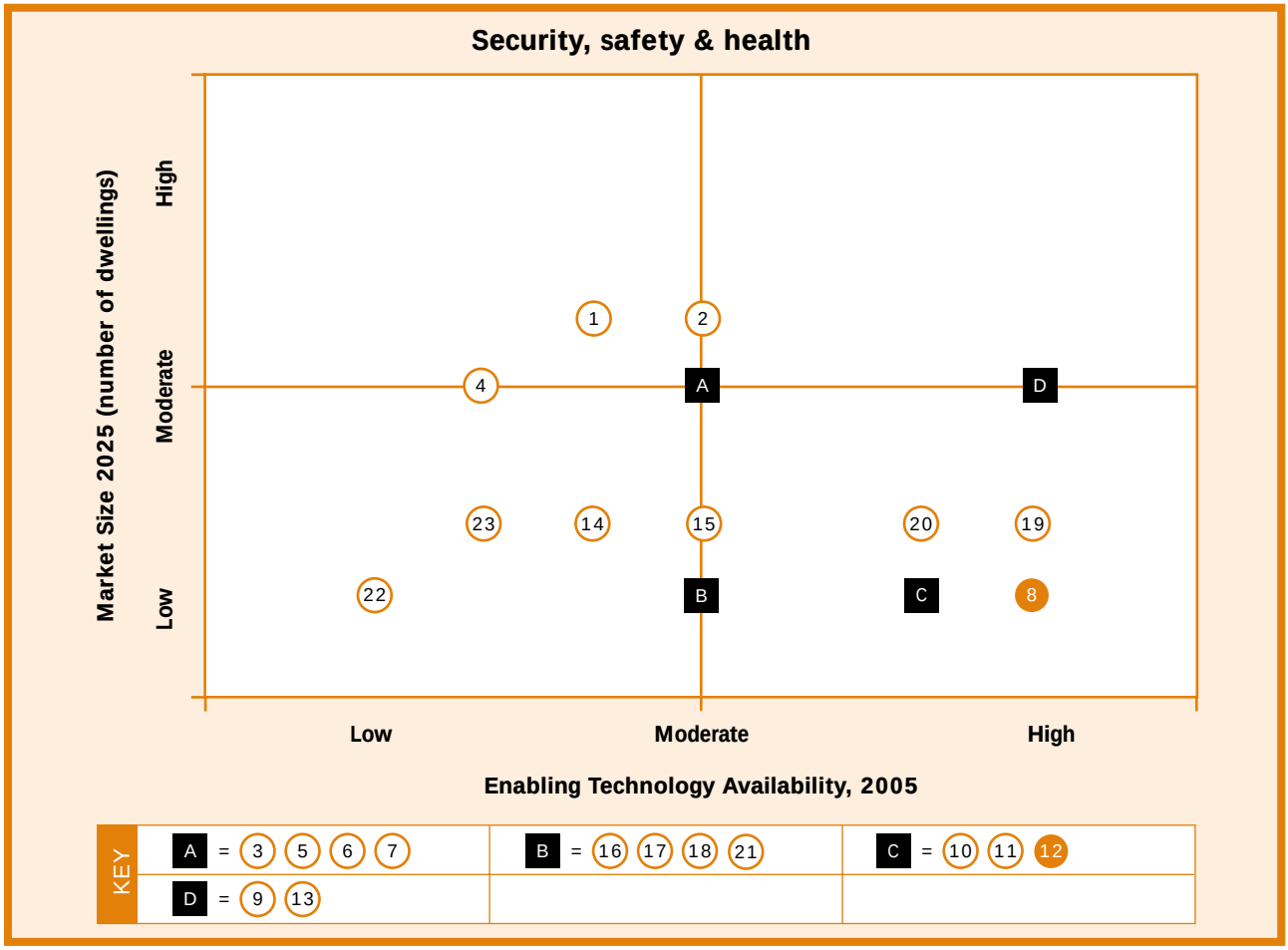
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Fail-safe security for data transmission	• Security of funds transfer and privacy issues	1. Improved firewalls against hackers 2. Cryptography
• Redundancy for safety of systems	• Need to immediately recall systems	3. In-built redundancy to allow at least two or three back-up modes in the event of subsystem failures 4. Embedded technologies will be inherently redundant
• Security against unauthorised entry	• Safety against intrusion of strangers	5. Auto-locking or screens/shutters 6. Smart card, biometric and video camera security systems for access 7. Remote access to system
• Central locking	• One operation instead of many to lock the house	8. Electric or electro-mechanical door and window locks and shutters*
• Video intrusion monitor to central control	• Remote surveillance	9. Cameras located in key areas, including front door
• Auto grey water sprinklers	• Fire protection external	10. Sprinklers connected to roof ring main 11. Remote sensors incorporated 12. Non-flammable materials of construction*
• Smoke detectors to central monitor	• Fire protection internal	13. Detectors interlinked with remote monitor
• Remote medical monitoring to health clinic	• Allows extended independent living for the elderly • Reduces need for institutional beds • Face-to-face doctor contact at a premium	14. Home based medical monitoring through sensors 15. Data fed back to central base
• Monitor and filter germs, bacteria, dust, pollen and pollution	• Maintain healthy environment with increasing health risks • Need to counter sick buildings	16. Family of filters (some nanotech) required to be inserted in air/water flow within the house 17. Use of materials with reduced or zero vapour off gases (VOG) or other harmful emissions
• Detect and monitor human activity	• Check on occupants' condition	18. Sensors (breathing or motion) connected by wireless and/or wire back-to-base
• Local area networks	• Allows remote access to neighbours	19. All dwellings connected to broadband
• Non-toxic materials	• Eliminate possibilities of allergies or illness from gas-off etc	20. Chemically inert materials and products
• Shielding from EMF	• Avoid possibility of cancer	21. Shield wireless technology 22. EMF-less wireless technology
• Embedded technology	• Need to combine many of above modalities in reliable, comprehensive coverage but unobtrusively	23. As for Characteristic 3 (22-25)

* of particular interest to the Copper Industry

Potential industry participants

- Physical security hardware manufacturers and suppliers, e.g. smart cards, cameras, locks, screens/shutters, smoke detectors etc
- Software providers of improved firewalls etc
- Companies providing remote medical monitoring devices
- Medical centres capturing and monitoring the above by remote
- Telcos providing improved broadband services
- Fire protection equipment suppliers

MATRIX 5



Sample interpretations

Item 10 – Sprinklers connected to roof ring main.

Technology availability:	High-moderate
Market potential:	Low
Potential industry participants:	Plumbers and electrical installers; plumbing and electrical hardware suppliers; thermal sensing installers.

Item 14 – Home based human medical monitoring.

Technology availability:	Moderate-low
Market potential:	Low-moderate
Potential industry participants:	Medical sensor and device manufacturers; remote medical monitoring centres with GP access; electrical/electronic installers; fast medical response teams/individuals.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 6:

User-friendliness, comfort & aesthetics

Increasing technological advances for systems, appliances and services require that they are user-friendly and with simple controls. This applies to room ambience, environment and furniture.

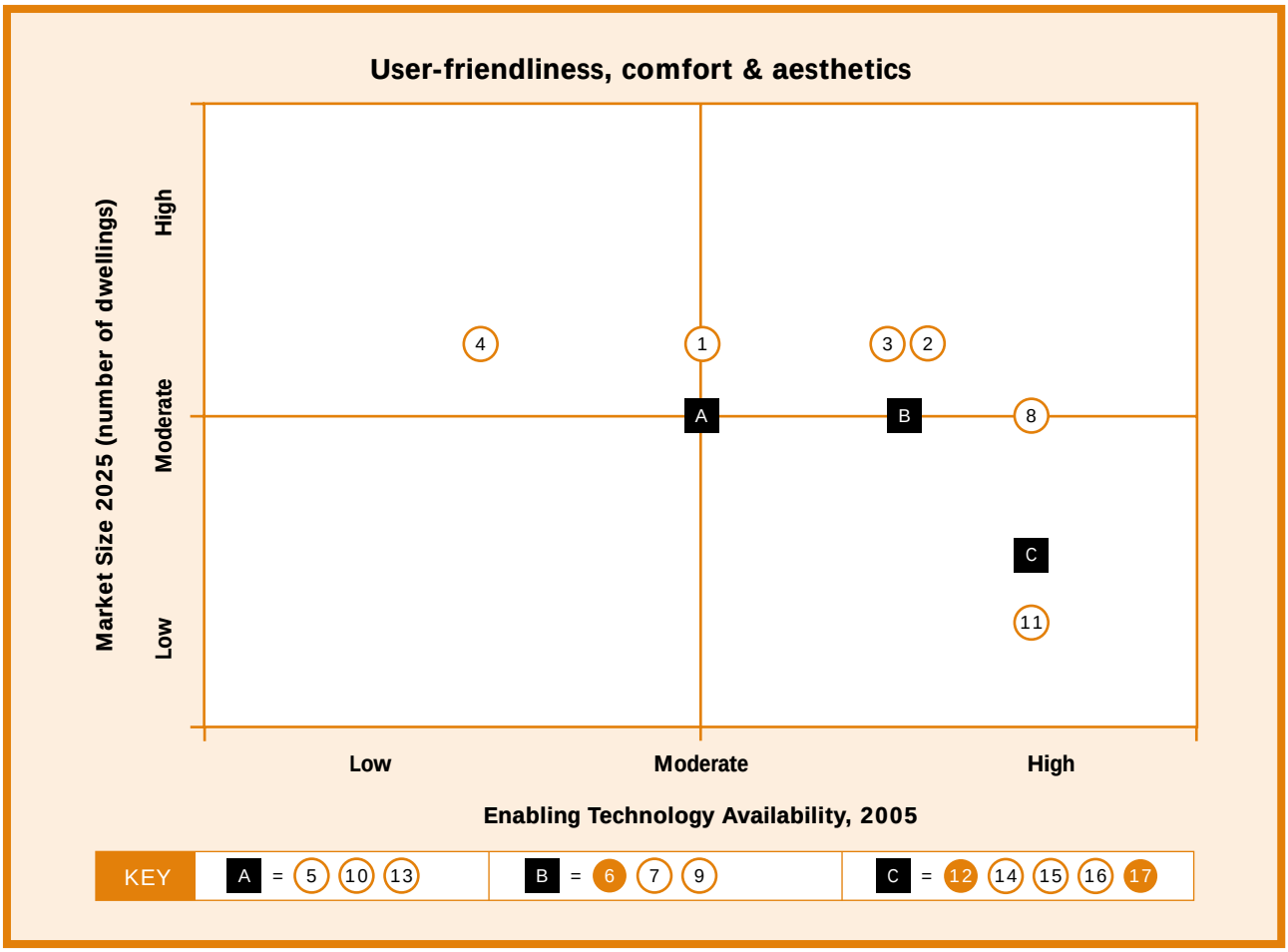
TRENDS	ISSUES	ENABLING TECHNOLOGY
• User-friendly systems and controls	• Multiple pin numbers • Different protocols and systems don't talk to each other • Must have intuitive controls	1. Convergent technology to create one PIN 2. Simple icons on touch pads 3. Readable manuals for lay people 4. Voice activation in combination with artificial intelligence
• Convergence of controls	• Systems, appliances and communications have a myriad of differing controls	5. One pin number 6. Simple icons* 7. Readable manuals for lay people
• Aesthetic technology hardware and installations	• Designs to fit in with furnishings	8. CAD/CAM designs with hidden wiring and bunched cables
• Automatic environmental controls	• Maintain desired environment	9. Sensors back to operating/controlling computer monitoring natural ventilation, thermal information and gas
• Light control, including sunlight transmission	• Full visible spectrum lighting	10. Fibre optics, nano coatings to wall and ceiling, LED sources
• Automatic sound control	• Ambience	11. Adjusts to ambient background
• Multi-positional chairs and beds	• Infinite adjustment for elderly or disabled	12. Electric motor-driven car seats, hospital beds, etc*
• Ambience	• Colour change	13. Fibre optics, LEDs, nano coating
• Reduce mechanical heating and cooling with natural passive air control and dwelling orientation with suitable eaves overhang.	• Reduce power consumption and improve air quality	14. House designed for natural flow-through ventilation principles as a focus 15. Shell structure to have min R3.0 16. Eaves overhang or other appropriate shading 17. Computer-controlled windows, shades, shutters*

* of particular interest to the Copper Industry

Potential industry participants

- Computer software specialists
- Environmental control designers, manufacturers and installers
- Insulation suppliers
- Furniture manufacturers – remote controls
- Bed manufacturers – remote controls
- Lighting manufacturers – fibre optics, organic LEDs, system fluorescents
- Fenestration (window) manufacturers
- Architects, designers

MATRIX 6



Sample interpretations

Item 1 – Convergent technology to create one PIN or remote control device.

Technology availability:	Moderate
Market potential:	Moderate-high
Potential industry participants:	Software developers for computer appliances and devices; appliance and device manufacturers.

Item 12 – Multi-positional chairs and beds for the home-based elderly.

Technology availability:	High
Market potential:	Low-moderate
Potential industry participants:	Product designers; auto industry electric motor operated seat suppliers; furniture and bed manufacturers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 7:

Home operations base

Internet technology is enabling the home to become the future office for a large number of workers. Many will take this option to avoid long daily travel.

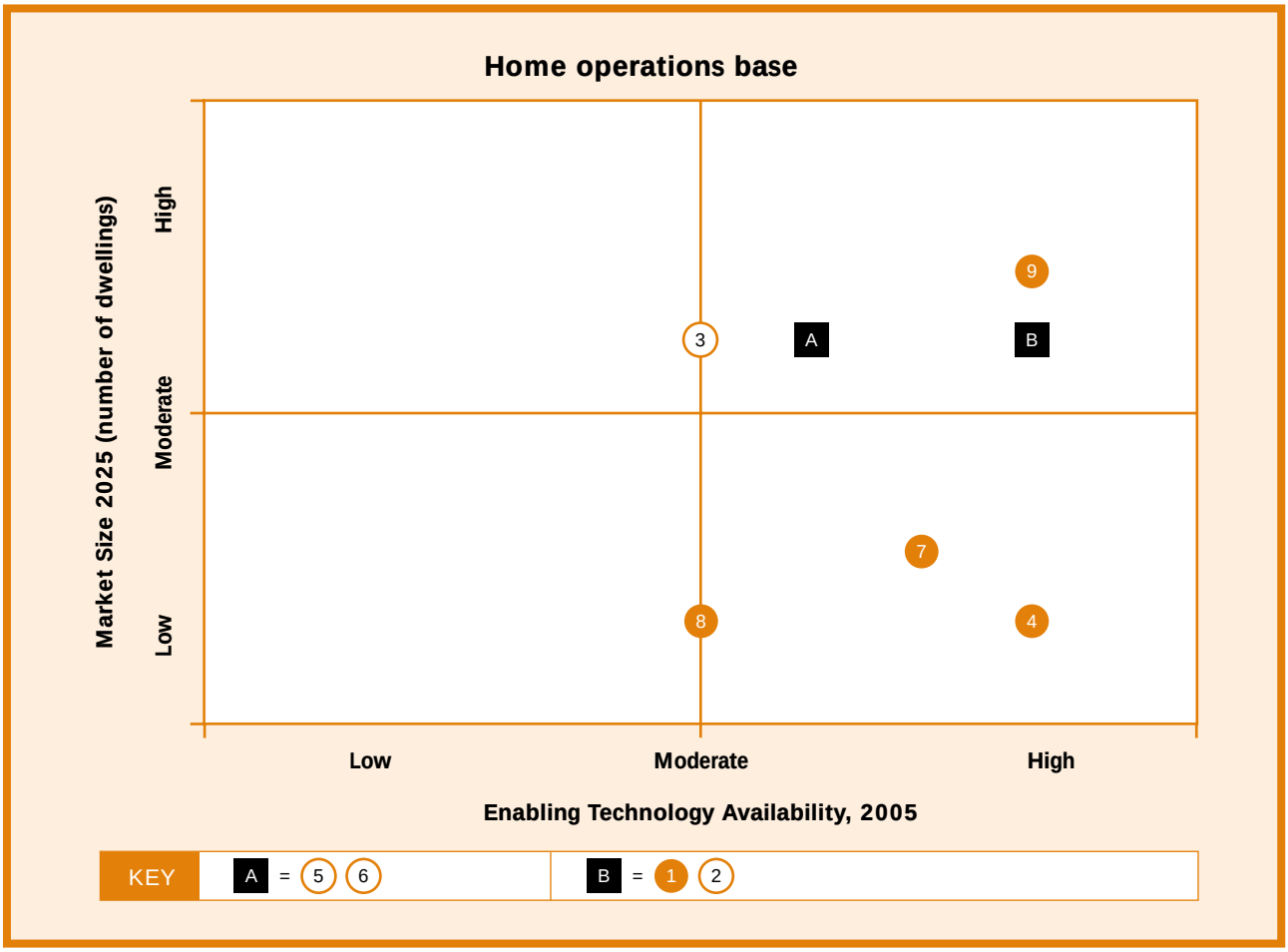
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Broadband throughout the house. Multi-power access	• Instant access to all data bases • Office and broadband access capabilities in every room • Increasing use of wireless technology	1. Smart wiring. Slimline ribbon wires* 2. Easy access cable ducts/skirting. 3. Directionless wireless systems, no dead spots
• Flexible power supplies	• Hardware and appliances using different voltage. Too many transformers	4. Cable or solid bus installed for 12 volt (a number of voltage standards have been mooted)
• Convergence of technologies	• Too many PINs and access protocols	5. Convergent software and common protocols, touch pad icons, simplified user manuals 6. Bridging hardware connectors with smarts built-in to enable communication across protocols*
• Seamless transfer of rooms to office with flexible equipment locations	• Easy transition for specific rooms from one use to another or transfer from one room to another	7. Smart wiring/wireless and cable ducting. Wireless locations avoid dead spots*
• Holographic and video conferencing	• Eliminates some face-to-face meetings. Allows several people to participate	8. Smart wiring/wireless plus connected screens and video cameras*
• Communications inter-linked rooms	• Enables intra-house as well as external communication	9. Smart wiring/wireless*

* of particular interest to the Copper Industry

Potential industry participants

- Battery manufacturers
- Electrical/electronic manufacturers and equipment suppliers
- Electric and fibre-optic cable manufacturers
- Electricians and electrical device installers
- Aluminium and plastic extrusion companies
- Suppliers of bridging hardware to enable communication across protocols

MATRIX 7



Sample interpretations

Item 1 – Smart wiring to allow flexibility throughout the house.

Technology availability:	High
Market potential:	Moderate-high
Potential industry participants:	Designers and manufacturers of slimline skirtings and vertical ducting, specialist retro-fit installation electricians.

Item 4 – Cable or solid bus to run separate voltage for appliances.

Technology availability:	High
Market potential:	Low
Potential industry participants:	Cable manufacturers and extrusion or skirting companies; electrical installers/installations, service engineers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 8:

Entertainment

The advent of broadband communication has enabled a wide variety of entertainment to be delivered to the home. This is creating the phenomenon of the home theatre. The feature of the home theatre is addressed.

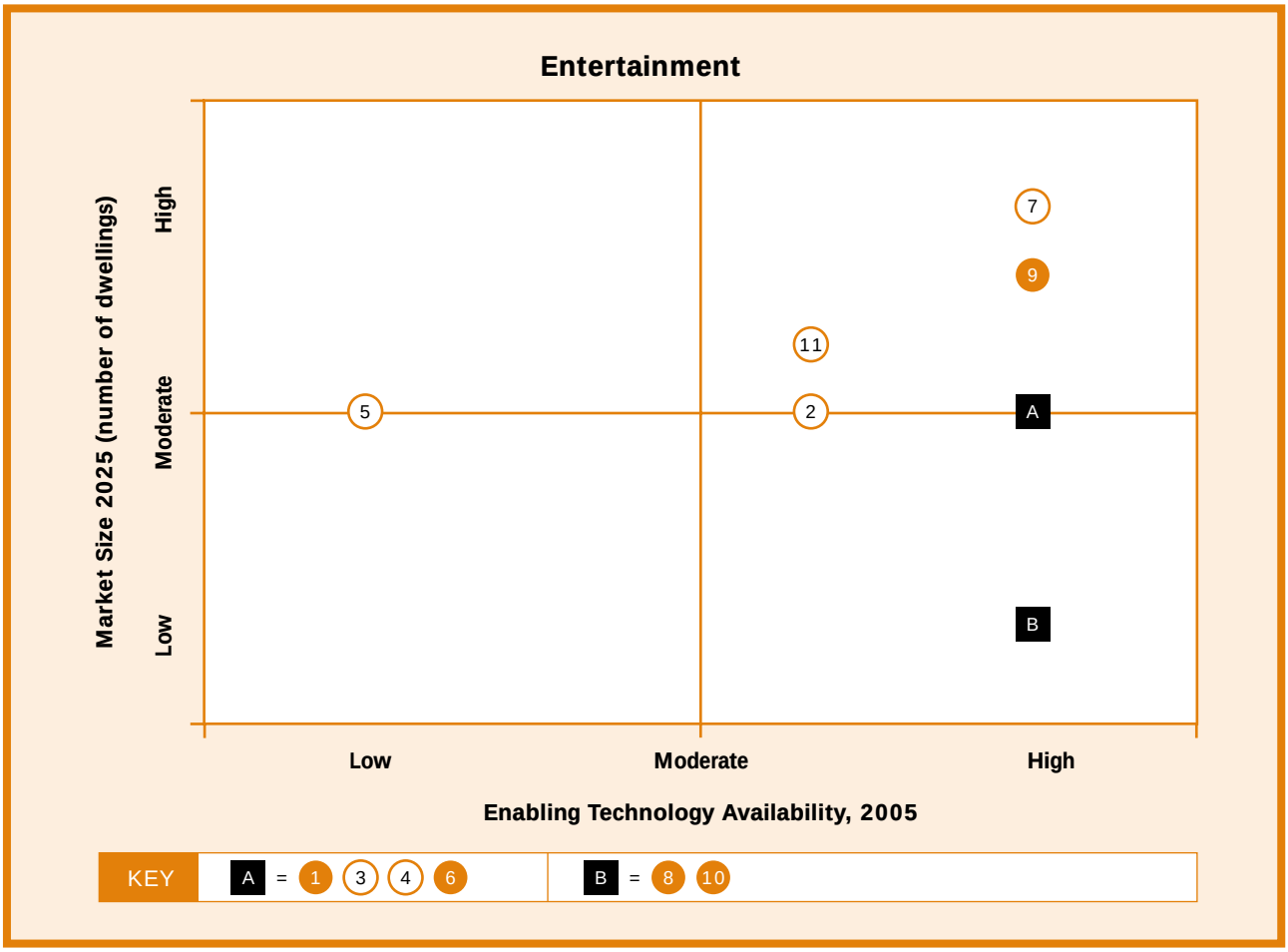
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Home theatre	• Family rooms being superseded by or quickly converted to a movie/DVD/games room	1. Smart wiring in ceiling as well as walls* 2. Wireless & cable compatible transmission 3. Multi-use projectors. Auto screens and curtains 4. 60 dba acoustic room (existing technology refined into complete package) 5. Noise-cancelling surfaces
• Ducted music	• Ambience throughout	6. Smart wiring in walls*
• Flat screens	• Pricing dropping with volume	7. New display technologies – plasma, LCD, OLEDS
• Enviro pleasure chairs	• Real sensory entertainment experience	8. Ducted air, moisture spray, and low frequency vibrators fitted to lounge viewing chairs*
• On-demand content streaming	• Wide variety of programs available on websites	9. Communications and data cabling (smart wiring)*
• Exercise gaming machines	• Provide indoor physical activity	10. Smart wiring*
• Convergence	• Eliminate multitude of remote controls	11. One remote control device for the house

* of particular interest to the Copper Industry

Potential industry participants

- Builders/designers
- Electrical/electronic manufacturers and equipment suppliers, e.g. projectors, DVDs, ducted music, exercise gaming machines
- Electric and fibre-optic cable manufacturers
- Electricians and electrical device installers
- Aluminium and plastic extrusion companies
- Suppliers of bridging hardware to enable communication across protocols
- Flat screen manufacturers
- Sensory furniture and hardware

MATRIX 8



Sample interpretations

Item 1 – Smart wiring to allow flexibility throughout the house.

Technology availability:	High
Market potential:	Moderate-high
Potential industry participants:	Designers and manufacturers of slimline skirtings and vertical ducting. Specialist retrofit installation electricians.

Item 4 – 60 dba theatre/entertainment room. Requires good insulation.

Technology availability:	High
Market potential:	Moderate
Potential industry participants:	Electrical installers/installations; service engineers; builders/designers, particularly retrofit.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 9:

Smart services, appliances & fittings

Technology is creating new opportunities to deliver on the above ‘smarts’. Some of the key areas are addressed.

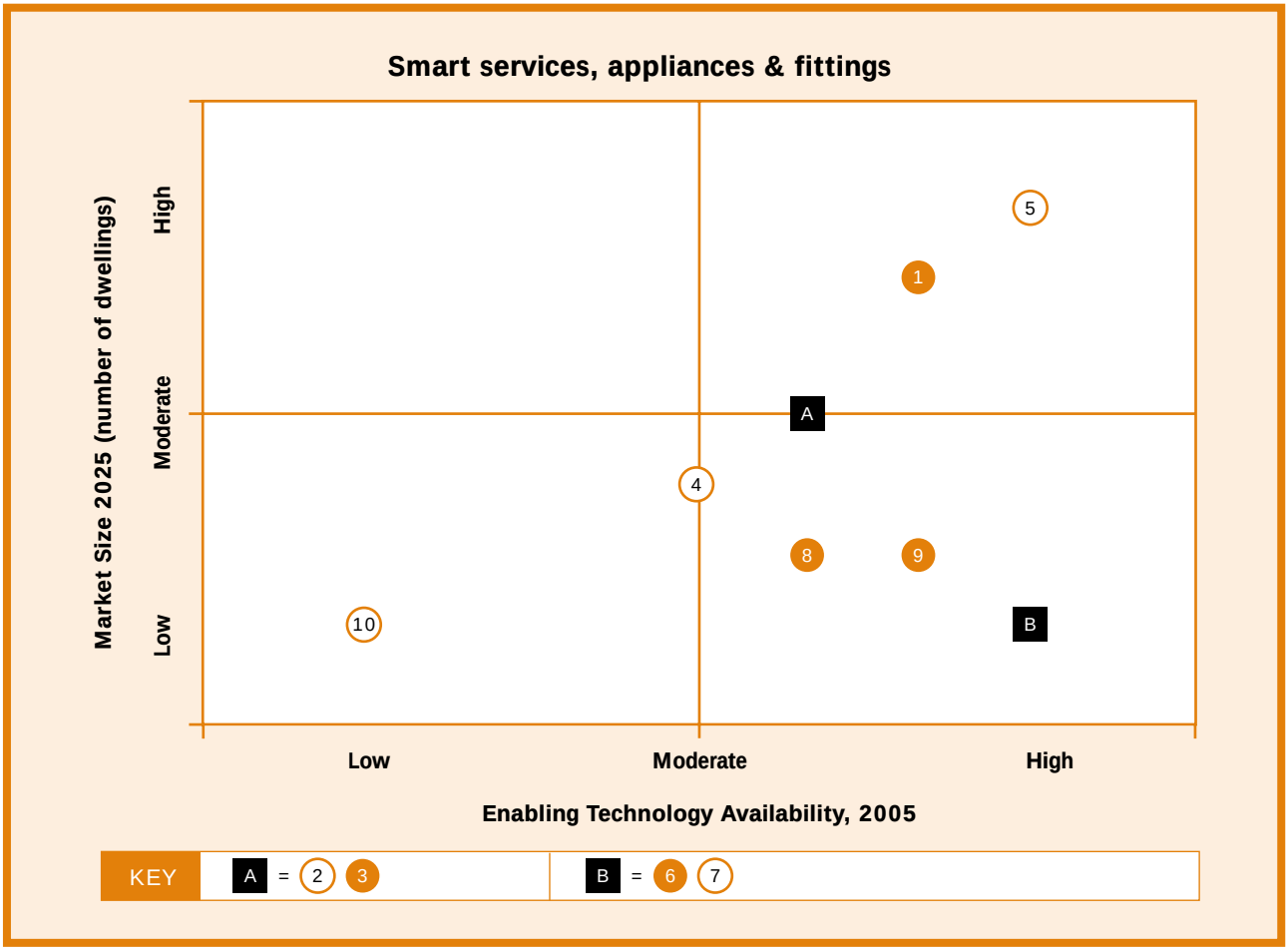
TRENDS	ISSUES	ENABLING TECHNOLOGY
• Online services – remote access	• Increasing developments of Internet capabilities	1. Smart wiring plus wireless (radio) transmission. Access to broadband*
• Program-linked appliances	• Cutting power peaks	2. Common protocol for appliance controls. Could be a smart plug
• Program-linked functions	• e.g. alarm, radio, lighting and curtains interlinked for morning wake-up	3. Smart wiring and common protocol. Smart plug*
• Programmed cooling and heating	• Maximising comfort • Minimising power consumption	4. Smart windows (photovoltaics and energy-harvesting coatings) and shutters, interlinked with air conditioning or natural ventilation
• Online software update	• Updates operation of appliances, functions etc	5. 24/7 link to Internet
• Mandatory water saving devices	• Water savings, environmental sustainability	6. Taps, valves fitted with tamper-proof restrictors* 7. Pressure pump could provide high-pressure, low-flow shower heads
• Low-waste gas or electric element water heaters	• Eliminate initial cold water line flow	8. Instantaneous heating at outlet of stored hot water* 9. Alternate instantaneous gas heating*
• Reset button	• Computer or appliance failure	10. Re-boot and reset button at both device level and house OS level

* of particular interest to the Copper Industry

Potential industry participants

- Fenestration industry – smart windows
- Electrical/electronic manufacturers and equipment suppliers
- Electric and fibre-optic cable manufacturers
- Smart appliances – program linked to cut power peaks
- Electricians and electrical device installers
- Aluminium and plastic extrusion companies
- Suppliers of bridging hardware to enable communication across protocols
- Plumbing supplies – mandatory restrictions
- Instantaneous hot water heater manufacturers

MATRIX 9



Sample interpretations

Item 3 – Smart wiring and common protocol. Smart plug for appliances (program-linked functions).

Technology availability:	Moderate-high
Market potential:	Moderate
Potential industry participants:	Designers and manufacturers of slimline skirtings and vertical ducting; ribbon wire manufacturers; specialist retrofit installation electricians; electrical/electronic appliance and device manufacturers.

Item 4 – Smart windows (photovoltaics and energy harvesting coatings) and shutters, interlinked with air-conditioning or natural ventilation.

Technology availability:	Moderate
Market potential:	Moderate-low
Potential industry participants:	Electrical installers/installations; service engineers; builders/designers, particularly retrofit; fenestration industry; photovoltaic suppliers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

CHARACTERISTIC 10:

Maintenance management

It is now possible to initiate and maintain a significant and comprehensive database on the condition of the dwelling. This holds opportunities for a major change in the approach to dwelling maintenance and servicing.

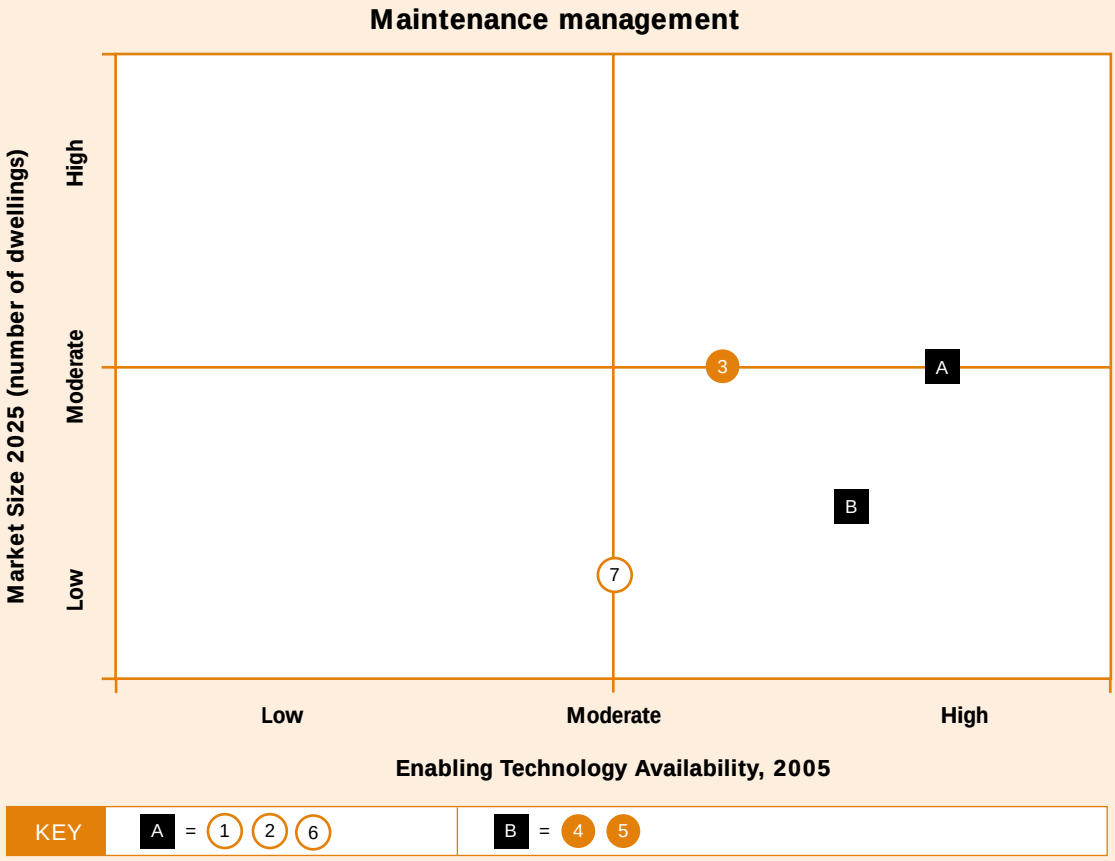
TRENDS	ISSUES	ENABLING TECHNOLOGY
• As-built CAD drawings with updatable capability to record maintenance	• Knowledge of building details facilitates subsequent alterations and servicing	1. CAD/CAM manufacture and data capture throughout the construction phase
• Operations manuals for the building, including its maintenance and appliances	• Education of occupiers, tradesmen and maintenance personnel	2. Manual produced by builder with input from all suppliers of product, appliances and services
• Automatic condition monitoring	• Maintains building and systems in good condition	3. Automatic data collection feeding into repair or maintenance schedule*
• Automatic monitoring of structural defects	• Enables preventative maintenance	4. Embedded sensors and strain gauges*
• Diagnosis of equipment malfunctions and auto repair of computer-based problems	• Enables preventative maintenance	5. Sensors embedded in structure and in appliances*
• Low-maintenance self-cleaning coatings	• Cleaned with rain etc	6. Nanotech coatings – TiO2 (photocatalytic), Si-based (lotus effect)
• Long-life materials and coatings	• Lower end costs	7. Apply life cycle costing comparisons

* of particular interest to the Copper Industry

Potential industry participants

- Builders/designers
- CAD/CAM providers
- Instruction manual writers
- Aluminium and plastic extrusion companies
- Coatings companies including nanotech (TiO2) coatings

MATRIX 10



Sample interpretations

Item 1 – CAD/CAM manufacture and data capture through the construction phase.

Technology availability:	High
Market potential:	Moderate
Potential industry participants:	Builders/designers; building materials suppliers; paint and coating companies; micro- and nano-sensor manufacturers and installers.

Item 4 – Nanotech coatings (self-cleaning, superhydrophobic, oliophobic etc).

Technology availability:	High-moderate
Market potential:	Moderate-high
Potential industry participants:	Coatings manufacturers, maintenance and building service companies, manual writers.

Note: *The size of the market and the state of technology is a view of the panel only. Industry needs to exercise its own judgement for its particular purposes.*

BUILDING CONSTRUCTION TECHNOLOGY ROADMAP

Part 4

END

go to Part 5: Impacts on Copper >>