Submission related to:

The emergence and impact of
Microgrids and Associated Technologies in WA

Committee: **Economics and Industry Standing Committee**

Appearance: **Yes**, willing to appear before the Committee

Perspective: **Agree** with the evolution of such 'disruptive' technologies

Name Donald YATES BAppSc BCommEng CertRenewEngy
Org. COLUMBUS Group
Position: CEO
Contact: 08 9379 9479
columbusgroup @ iinet.net.au
10 Thompson Rd
Success Hill WA 6054

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Contents: Reasoning

Reasoning: Since the establishment of water wells and windmills on private property, the concept of microgrids and associated technologies has been present for some 8,000 years. Maybe the windmill was proposed even longer. Bartering of the resulting produce 'over the fence and/or with the adjoining cave dwellers' added the commercial exchange basics.

Wikipedia: "A water well is an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers. The well water is drawn by a pump, or using containers, such as buckets, that are raised mechanically or by hand. Wells were first constructed at least eight thousand years ago and historically vary in construction from a simple scoop in the sediment of a dry watercourse to the stepwells of India, the qanats of Iran, and the shadoofs and sakiehs of India. Placing a lining in the well shaft helps create stability and linings of wood or wickerwork date back at least as far as the Iron Age.

Wikipedia: The windwheel of Greek engineer Heron of Alexandria in the first century is the earliest known instance of using a wind-driven wheel to power a machine. Another early example of a wind-driven wheel was the prayer wheel, which has been used in Tibet and China since the fourth century.

(Hopefully local council rangers at the time did not regard prayer wheels as a source of unwanted neighbourly noise pollution: Yates).

It has been claimed that the Babylonian emperor Hammurabi planned to use wind power for his ambitious irrigation project in the seventeenth century BCE

In other words, Microgrids and associated ('disruptive') technologies are not a new phenomenon, but rather examples of repackaging to suit/support community needs in the 21st century, where reliance on:

(A) centralised systems for provisioning of various utilities to meet immediate community needs,

(B) quality of supply,

(C) reliability of the services,

(D) delivery charges subject to political interference,

(E) centralised annual budget capital funding infrastructure,

(F) compliance with all standards and safety regulations

are now open to the challenge by cost-effective (and renewable 'feel good') neighbourly alternatives.

1.0 System parameters - specifications for supply flexibility and safety

Energy Safety Division (Energy Safety) of the Department of Commerce, following consultations with network operators and electrical contracting industry groups in Western Australia, issued the updated version of the Western Australian Electrical Requirements (WAER).

Electrical installation designs after 1 July 2008 must comply.

1.1 Safety standards to be considered and included where applicable

• **AS/NZS: 3010.1**: Electrical installations – generating sets.
When the generator is driven by an internal combustion engine set

• **AS 4509**: Stand alone power systems.
For renewable energy power supply systems

• **AS/NZS 4777**: Grid connection of energy systems via inverters

• **AS/NZS 5033**: For photovoltaic systems

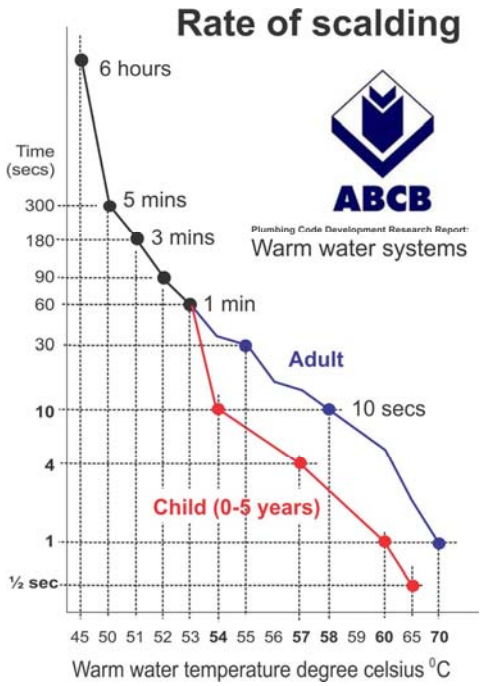
• **AS IEC 61400.2 - 2013** Small wind turbines

• **AS 1210 -2010** Pressure systems as part of any geothermal system

• **AS/NZS 3500.4**: Water storage must be at a minimum temperature of 60 degrees celsius to inhibit growth of Legionella bacteria.

Care should also be taken against warm water scalding. See comparative graph for adults and children of time exposure with warm water.

Some Microgrid systems may have water storage components and exposed pipework so 'rate of scalding' awareness should not be forgotten.



1.1 Suggested operating voltages

The linking of microgrid systems to the operational nominal voltages of cars and transport generally, may pose challenges with the changing standards over the decades, from the nominal 6 volt FX Holden to 12 volt Fords, 24 volt trucks, old 32 volt sleeper carriages, 48 volt higher voltage cars like Mercs all the way up to the nominal 350-400 volt Teslas. (See pics below).






There have also been 42, 60 and 120 volt car systems over last 20 years.

Similarly, battery powered electric power tools have ranged in voltages from 3.6 volts to 7.2, 9.6, 14.4, 15.6, 18, and even up to 36 volts DC.

There are other 'classic' voltage systems like copper connected phones that have been around 6 volts when off the hook and 48-52 DC volts when on the hook, depending on the distance to the exchange, the number of phones on the party line and the condition of the copper wire connections.

Small, silenced gensets are also popular. The common outputs are usually 12 volt DC and 250 volts AC for maximum flexibility, sometimes variable where the speed governing systems can be bypassed.

It is recommended that any electrically operating systems of microgrids and associated technologies be limited to 48 volts DC, with the provision of 12 volts DC, for maximum flexibility, neighbourhood safety, working with the recent supply of electric and hybrid cars plus many battery options.

Where '250 volts and higher AC' is installed, this and associated wiring and earthing through Multiple Earth Neutral (MEN) connections at the point of main switchboards should be outside the scope of microgrids, and where non-qualified installers may be exposed.

2.0 Microgrid energy input source options

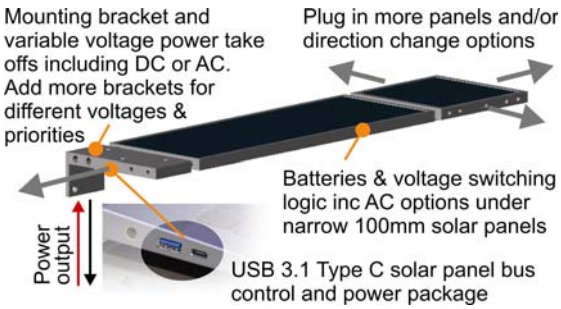
The normal suggested energy input options usually start with mains powered batteries, recharged off peak, to reduce the heavy demand periods imposed on the pole and wire distribution networks.

Other usual accepted energy input sources include:

Wind turbines
Solar arrays (such as photovoltaic and thermal electric salts)
Fuel cells (town gas, bottled gas, biomass, methanol generators)
Small ICE camping generators (petrol, diesel)
Exercise bikes (with attached generators)
Micro-hydro (inflow mains water, high rain water tank generators)
Shallow depth geothermal (particularly solid state vs steam)
Waste hot water heat energy scavenging (washing & showering etc)
Thermal energy from fires and under driveways (battery effects)
Swapping batteries with neighbours (can be done autonomously)
Swapping water tanks, pressurised & non-pressurised
EV's and other vehicles - tapping into their batteries

2.1 Microgrids should be able to be easily expanded with growth demand

The above Sustainability Award technology FINALIST (Oct 2017) is an example of easy expandability and installation, where the solar collector has build in batteries, and load sharing electronics to prioritise demands depending on the stored energy in the collective batteries. Opening gates and security lights for passing pedestrians would seem higher priorities than inductively recharging the remote electric lawnmower.



The narrow design and angled support bracket takeoffs makes the system easy to expand, quickly mount on shared fencing without climbing on the roof and also to provide the electrical energy 'distribution wiring without major wiring' and consumption monitoring detail in real time direct to your smart phone. Services like CCTV are also simple to add and even relocate along the fence line.

2.2 "Last metre" connections - "LIPS KISSing" at your window solution

The collection of local energy can be achievable without too much effort but connecting the wiring through doorways and windows to uses inside can be a serious security and safety situation. The solution can be LIPS KISSing inductive transmitter and receiver sets.

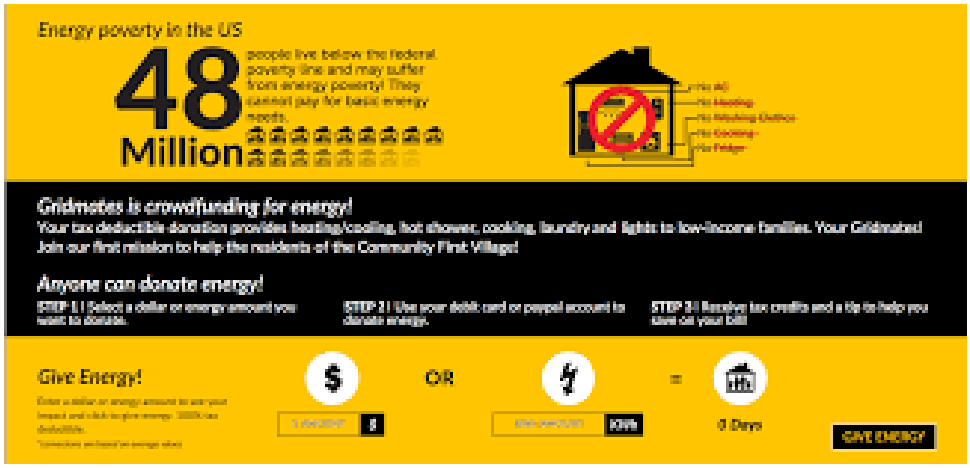
LIPS	**Local inductive power systems** where the input power (usually 12 volts DC) is transferred through glass inductively at a resonant frequency of 5.8GHz with a transmitter on one side (usually externally), and a collector on the inside.
KISSing	**Keeping it Simple Stupid** completes the transfer where the collector on the inside converts the power to 250 volts AC to easily power a range of items

2.3 Microgrids can earn external revenue - even when not grid connected

While selling electrical energy to external grids can be a source of net revenue and at the same time supporting the external grid, there are many other ways that individual microgrid systems, even when not connected to the main electricity grid.

Sale of gas and water metering data, via wireless mesh to suppliers
Powering nearby local government street lights under contract
Electric vehicle recharging - private (inductive or connected)
Public transport EV recharging (inductive during short transit stops)
Recharging autonomous passing robots and drones
Pre-waste treatments to extract biomass for embodied energy
Smart phone recharging
Waste water pre-treatment (cutting up blocking disposable nappies)
Stormwater aquifer recharge & harvesting - paid to move water
Stormwater flood control - insurance premium savings

2.4 Interactive virtual grid networks are here, see GRID MATES experience



GRID MATES

USA Texas: Direct Energy originated GRIDMATES, a neighbour-to-neighbour bill assistance program that enabled millennials to assist their lower-income neighbours with their energy bills after Hurricane Harvey. The bill assistance program uses Gridmates' cloud-based crowdfunding platform to leverage peer-to-peer energy sharing to combat energy poverty. Energy sharing allows a consumer to "share" energy with someone who is in need of energy assistance, through donations credited to their monthly utility bill. In addition to its crowdfunding capabilities, the platform also allows for donations processing and includes an energy calculator.

Direct Energy worked with Gridmates to create an online contribution centre to collect monetary donations in the wake of Hurricane Harvey, which battered the Texas coastline and created power outages that affected thousands of people. The contributions were calculated and translated into kilowatt-hours and the number of days of electricity the donations provide. Contributions were then distributed to 34 community action agencies across Texas, and the program has assisted more than 57,000 customers pay their electric bills. To date, more than 15,000 users have visited the site to donate and learn more about the program. https://www.gridmates.com/

Hurricane Harvey was a Cat 4 storm that hit Texas on August 25, 2017. It caused $125 billion in damage according to National Hurricane Center. That's more than any other natural disaster in U.S history except Hurricane Katrina.

Starting in 2007, Vodafone created a remote finance exchange system experience in Kenya, like GRIDMATES, where the basis of exchange was not in dollars and cents, but rather phone credits. This was the start of a whole 'remote banking system' where there were no such services for the wider community. (See M-Pesa).

There are parallels that can be applied in Microgrids that draw on various elements of the GRIDMATES and M-Pesa platforms.

Synergy have offered their supplied customers a choice of a percentage of the electricity service to be from 'green' renewable sources, usually at a price premium. This has proved quite popular for some years. This is a demonstration that supply grids are not as rigid and directly hard wired as once considered.

3.0 Local governments - participation for community-wide benefits

3.1 Historical background

As part of history being repeated, many local governments installed and ran neighbourhood-like power stations. I recall (from the markings on the building) that the Boulder Roads Board around 1930 had a low 32 volt DC system for nearby 'microgrid-like' electricity reticulation within a few streets of the generating station.

And then like the lighting systems on the sleeper trains (of old) that operated with the WAGR, these systems were also examples of multiple micro-grids, (on rail wheels), somewhat stand alone with batteries and gensets in the bogies to power the 32 volt lights of the compartments. (There were also neighbourhood cold water bags swinging in the breeze on the open to the air running boards at each end of the carriages)

3.2 Local governments could provide (again) their own microgrids

For the current 29 local governments of Perth and Peel, there are population growth targets to reach some 3.5 Million residents on or about 2050. (Dept of Planning, Lands and Heritage / WAPC 23 March 2018). With this planned growth, comes an estimated $300-$400 million for dealing with urban stormwater management alone from the urban infill.

While there are State Planning Policies like 3.6 Developer Contribution for Infrastructure, and with that Development Contribution Plans (DCP's), to offset such substantial costs, there is the possibility of channelling these DCP private funding of infrastructure resources to support a wide range of community services, including:

(A) stormwater management, including flood control, aquifer recharge and clean water delivery,

(B) improved and safer walkability (and sitability) services including bright footpath lighting, and

(C) setting up local government microgrids and infrastructure to generate returns to the community via their local government.

(D) Collected biomass like grass cuttings and prunings that are converted by a range of mechanisms into fuels and/or electrical energy that is stored in batteries (including ex- EV batteries with 'rebirthed' light drain demands) for exchange community support services and stand-alone path lighting.

3.3 With care, trapped methane 'tip gas' could be a source of local energy

A number of local governments have reserves that cover old rubbish tips. These areas are now often part of the green networks. Such waste deposits are often rich sources of 'rubbish tip' methane gas that can be bled off and used to generate substantial funds for community benefit.

In Cranbourne Victoria, a major real estate development had to be substantially stopped because of the trapped methane gas. Compensation of some $23 million had to be paid out. There could have been a much different outcome if managed better for all. (See below where 'explosive' methane gas is shown being bled off with new housing in background).

ABC News: **Gas leak victims win $23m payout (2011)**

"*The Victorian Supreme Court has ruled in favour of a multi-million-dollar compensation payout for people affected by a methane gas leak at Cranbourne in Melbourne's south-east.*

More than 750 homeowners from the Brookland Greens estate sued the City of Casey and the Environment Protection Authority (EPA) after they were forced from their houses because of methane coming from a disused tip in 2008. In 2009, the ombudsman found the EPA had failed to do its job.

The local council was also blamed for failing to act quickly enough to stop the gas from escaping.

The court has approved a settlement worth $23.5 million, with residents sharing more than $17 million once legal costs are paid.

3.4 Part played by superannuation funds could reduce State expenditure

With more than $2Trillion in public superannuation funds and around another $1Trillion in private superannuation sources, then ways to support microgrids using these funding sources could be investigated and recommendations made.

As an alternative to expanded network capacity of 'poles and wires' with urban infill, (see State Planning Policy 4.2 Activity Centres of Perth and Peel), with some 800,000 additional dwellings by 2050, a well planned roll out of microgrids could create a substantial support platform across Perth and Peel so the expanded centralised system of energy sourcing with generation and distribution may not be required, at considerable capital expenditure savings for State Utility Suppliers and by default, the State Government and the whole community.

For small inner city local councils like the Town of Bassendean, with 2018 statistics of15,180 people living in 10 square kilometres, the targets for population increases and additional housing will have a major impact.

TABLE 9: Existing and projected dwellings and population 2011-2050 / Town of Bassendean

Local government	Existing dwellings	Existing population	Additional dwellings	Additional population	Total dwellings	Total population
Bassendean	6,390	15,180	4,150	9,120	10,540	24,300

The above demonstrates existing & projected dwelling numbers based on draft framework scenario & anticipated growth

TABLE 10: Additional urban infill housing dwelling targets / Town of Bassendean

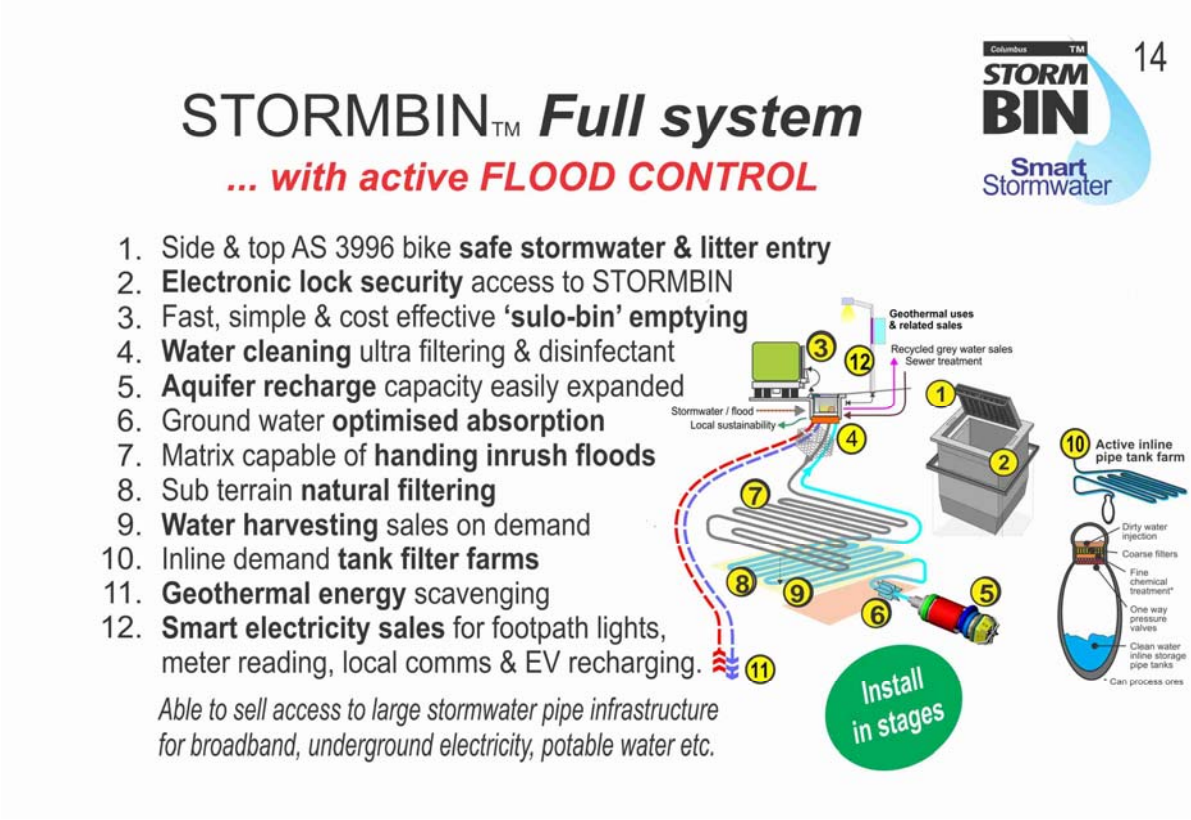
Local government	2011-16	2016-21	2021-26	2026-31	Total 2031	Post 2031	Total
Bassendean	700	550	650	530	2,430	1,720	4,150

Jan 2011 - Mar 2018
target: 950 extra homes

Actual is 30% below the Dept of Planning target with only 650 additional homes as at March 2018

Strategic Planning to accommodate the impact targets may have an important part to play by promoting networks of multiple microgrids for both electricity and clean water supply to meet the expected demands with superannuation funding support.

4.0 Private enterprise integrated systems - STORMBIN



STORMBIN is a disruptive technology based on intervention to divert potential flooding stormwater into underground aquifers by positive pumping, and with the opportunity to harvest such water, clean it, and distribute the water as needed on demand. These services can generate appropriate incomes.

In the same STORMBIN installation, it is possible to install new technology solid state geothermal renewable energy sourcing hardware that delivers electricity, on demand, 24/7, similar to a base load generator supply system, and without the need of large battery storage capacity.

The same geothermal energy supply can run the water movement pumps, power up footpath lights, operate a mesh network of water and gas metering that reports back to the centralised accounting control as needed, power up and operate commercial and emergency community networks, plus support electric vehicle recharging, while generating revenues to sustain such services on possible user-pays principles, that also repays the capital installation costs (possibly to superannuation funding entities) and any ongoing maintenance charges.

Stormwater control, infrastructure, footpath lighting and sewer pre-treatment are all services usually paid for by either State or Local Government instrumentalities, so the ongoing cashflow for such services that is paid to private enhanced private microgrid providers, may be viewed as yet another Public Private Partnership package.

4.1 Localised interconnection of stand-alone microgrid systems

It may also be feasible to have autonomous, stand-alone, enhanced intelligent microgrids be able to interconnect even for a short time into NETWORKS of connected STORMBIN SYSTEMS to have the capability to share resources, provide automated backup capabilities, meet localised heavy peak demands (even home based industry using high current draw hardware like welders), power sections of smart footpath lighting and water associated roadway green verges and nearby public open space.

The proposed mesh wireless metering of localised water and gas utilities already provides a redundant communication backbone to instantly setup and operate such interconnected NETWORKS, and to revert back to stand alone systems when no longer required. The GRID MATES exchange system of kilowatt hours (combined with kilolitres of water) already establishes the principles of the underlying accounting function control software.

4.2 Regional and remote industry applications of STORMBIN

While different to urban installations, regional and remote applications in support of tourist services and small communities could also benefit from microgrids, as provided for by STORMBIN technologies.

While the services may be less interconnected for redundancy, clean water supply and 24/7 power from geothermal renewable sources without reliance on batteries, the sun or wind, could be the necessary 'game changer' for a range of end users, from residential to mining and farming remote industry.

4.3 Local manufacture & worldwide installation of STORMBIN microgrids

All the options for microgrids could be manufactured for export from Western Australia. Supply to retailers like the *Bunnings Warehouses* of the world with the expandable solar system for fence mounting, (so easy to source and simple to install), makes it convenient for the DIY (do it yourself) 'weekend warriors' to access the hardware, and embrace the benefits.

STORMBIN hardware can also be manufactured locally for world export supported by local service companies operating internationally to efficiently do the installations. The key could be an application of the WA developed mining technologies that WON the 2014 and 2015 Australian Mining PROSPECT Awards for near-automated logical and rapid installations, akin to the worldwide service companies like Halliburton and Schlumberger that operate internationally in support of the oil & gas sector.