



Digital Power

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Is this the energy system's game-changer?

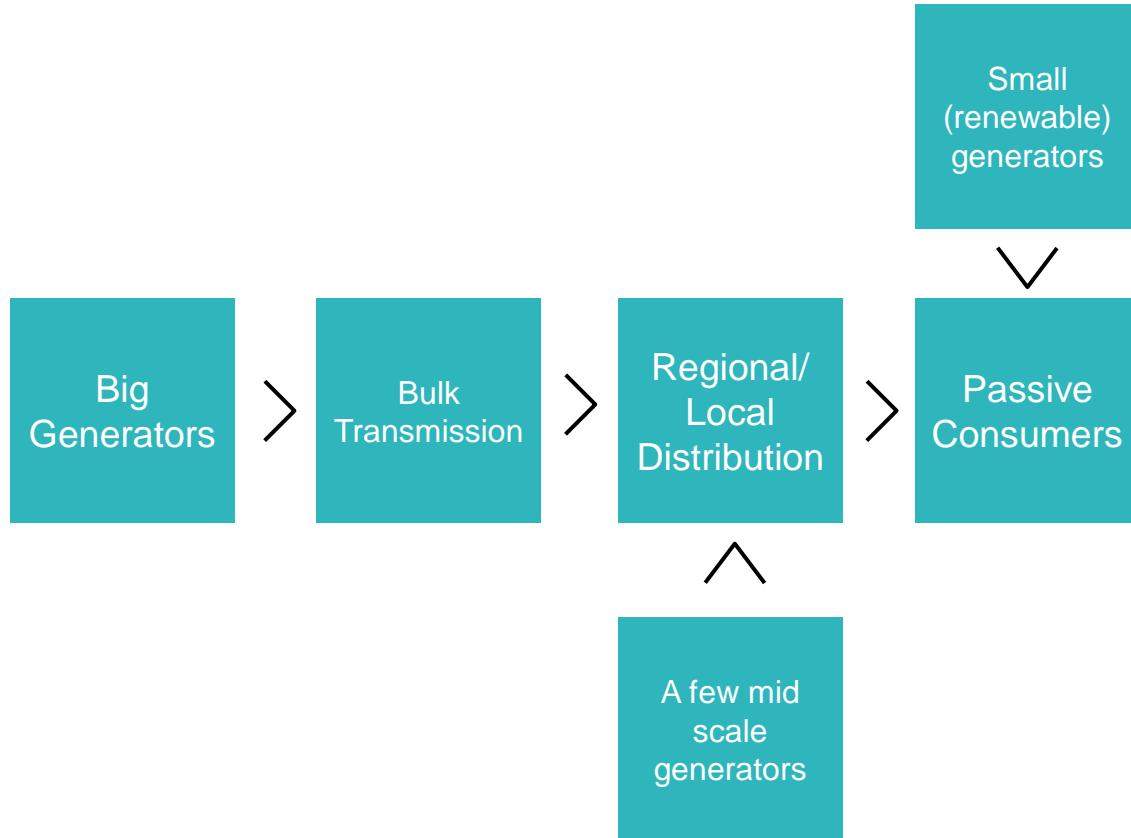


Transformation, challenge, opportunity

Contents

- Today's world
- What's driving change
- Tomorrow's world
- What gets unleashed for consumers and other infrastructures

Today – a top-down hierarchy (at least physically)



It's not just renewables

1

Communities

Real and virtual

2

Demand participation

Cheap capacity

3

Intermittent renewables

At all scales

4

Electric heat and transport

Massive impact on demand

5

Consumer tech

Disruptive and fast diffusing

6

Big data

Unlocks massive new opportunities – and threats



7

Changing consumer expectations

I want it now, without fail

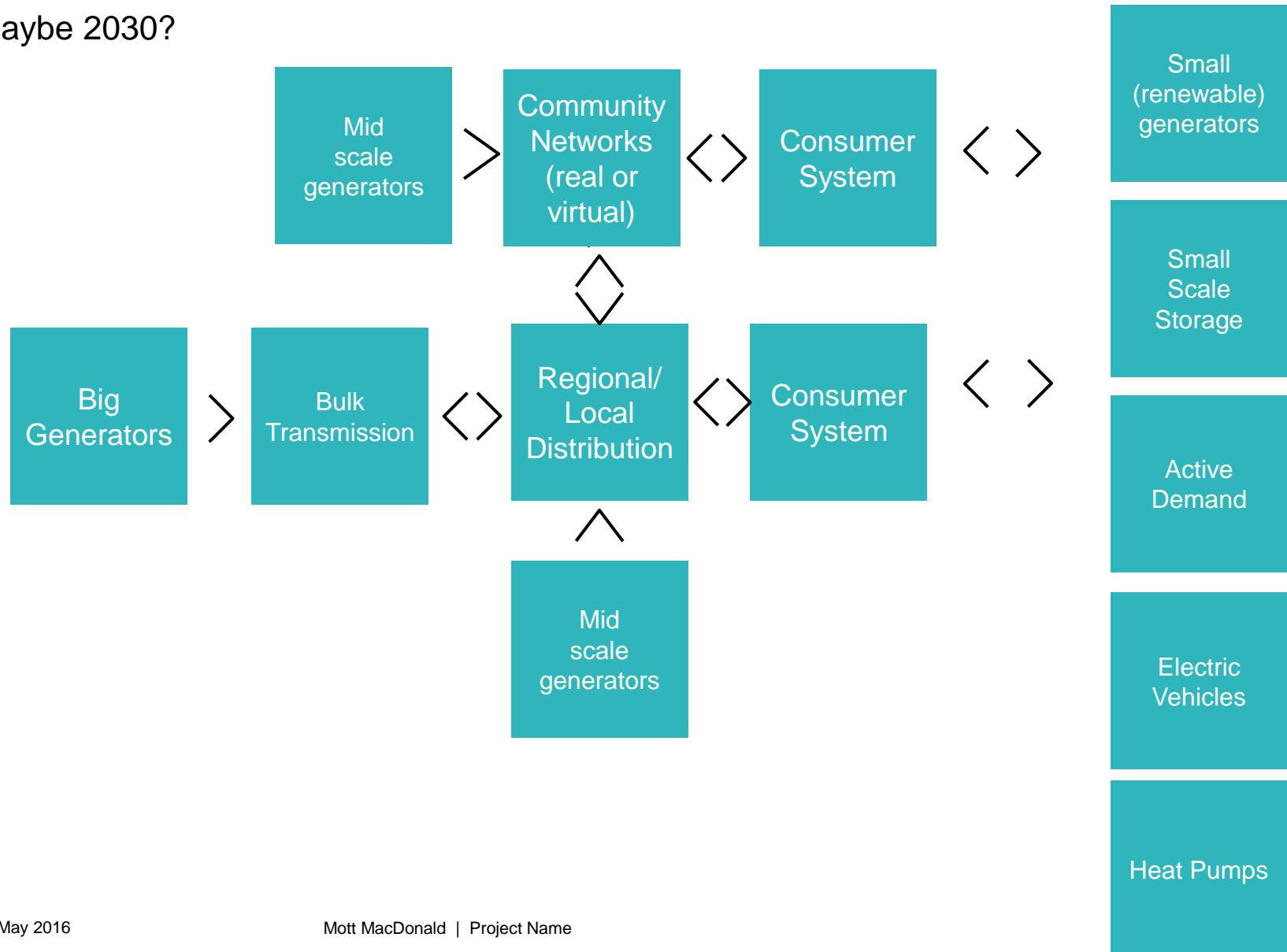
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Cross Vector interactions

Where power meets gas meets heat meets hydrogen meets?

Future – a much more complex and active system

Maybe 2030?



Upending a century of assumptions

“From a consumer’s point of view, the solar on the rooftop is going to be the baseload. Centralised power stations will be increasingly used to provide peak demand”

Stephen Holliday, National Grid, UK, 2015

We are writing a new playbook

“This industry is going through a tremendous transformation. We used to have a pretty good idea of what future needs would be. We would build assets that would last decades and that would be sure to cover those needs. That world has ended. Our strategy is now centred around agility and flexibility, based on our inability to predict or prescribe what our customers are going to want”

Stephen Holliday, National Grid, UK, 2015

Scale gets scary

10

Frequency
control
devices

10,000

Distribution
network
automatic
controls

600,000

Frequency
control
devices

900,000

Distribution
network
automatic
controls

0

Smart
Cities

60+

Smart
Cities

0

Automatic
controls in
homes

15million

Automatic
controls in
homes

Opportunity and challenge

We can

- Reduce costs by:
 - Finding new solutions to old and new problems
 - Maximising asset usage
 - Minimising carbon
- Empower innovators to plug and play
- Empower consumers to participate
- Improve resilience

We will have to

- Ensure cybersecurity within a loosely governed complex system with fragmented ownership
- Protect consumer privacy
- Ensure the system can cold start if it has to
- Find ways to be agile, noting the big assets take a decade or more to plan and build

How might infrastructure be leveraged for profit in future?

Demand control	Peer to Peer trading	Storage	Design in
Getting paid to provide system services	Self generation	Leveraging inherent storage opportunities	Distributed solar and wind
• Peak and valley smoothing	• Giving spare power to the local school	• As heat?	District heating
• Frequency response	• Selling spare power directly to buyers	• As battery charging	Hydrogen networks
• Voltage response		• Purpose made storage devices	Smart metering
• Network capacity management			Smart controls
			Internet of things
			Backup/islanding

When?

We simply don't know.
With fragmented
ownerships and intense
Silicon Valley interests
something quite disruptive
could happen quite
quickly....or not.

Clustering could create
localised test beds.



Thank you