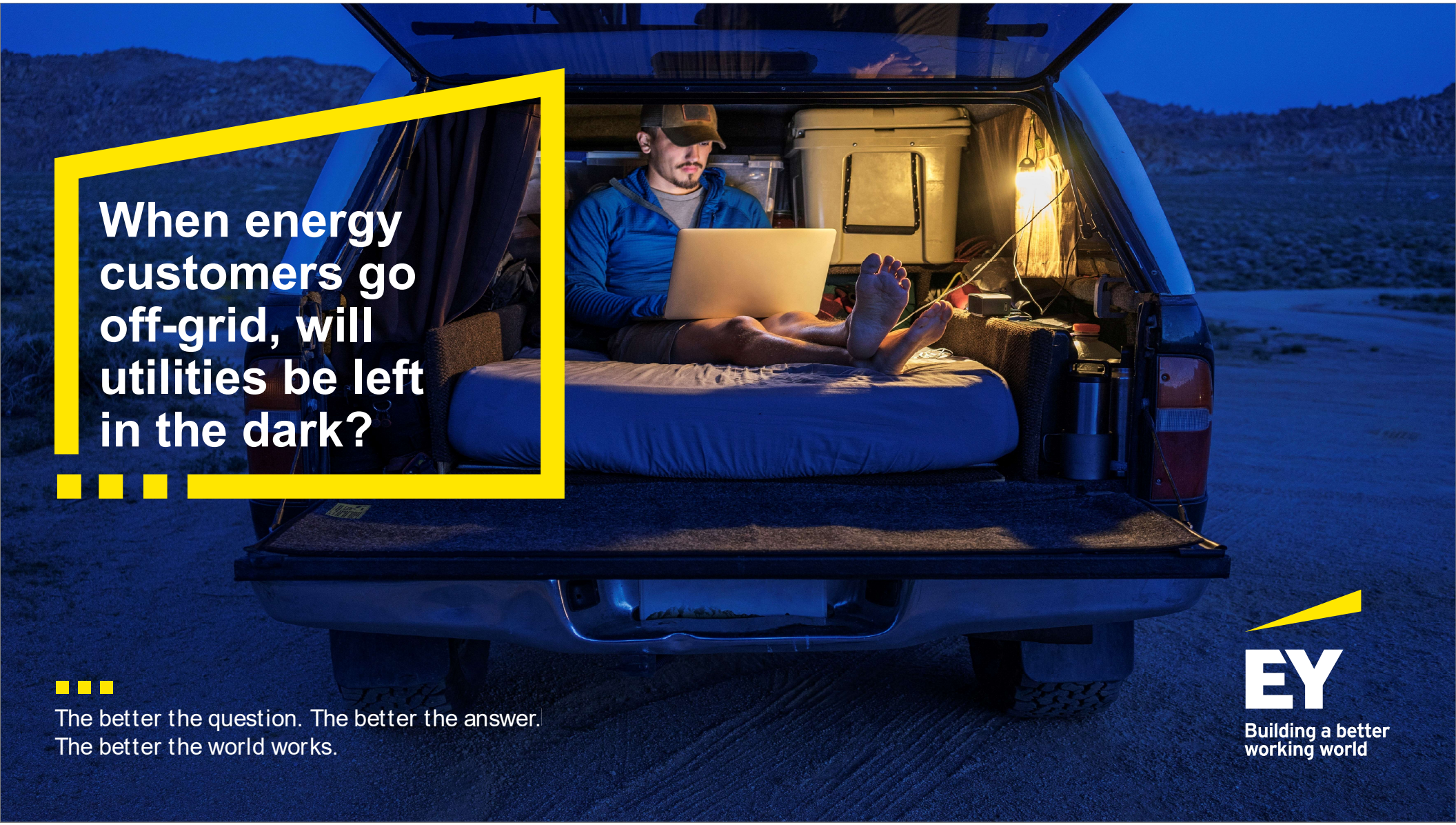

When energy customers go off-grid, will utilities be left in the dark?
The better the question. The better the answer.
The better the world works.
EY
Building a better working world

The future of power and utilities (P&U) is emerging rapidly and will materialize through three disruptive “tipping points”

Tipping point 1

“Grid cost parity” of non-utility* solar plus storage systems

The birth of the new energy system

Tipping point 2

The price of battery electric vehicles reaches cost parity and performance parity with ICE** vehicles

Electricity and mobility industry convergence

Tipping point 3

The cost of transporting electricity exceeds the cost of generating and storing it locally

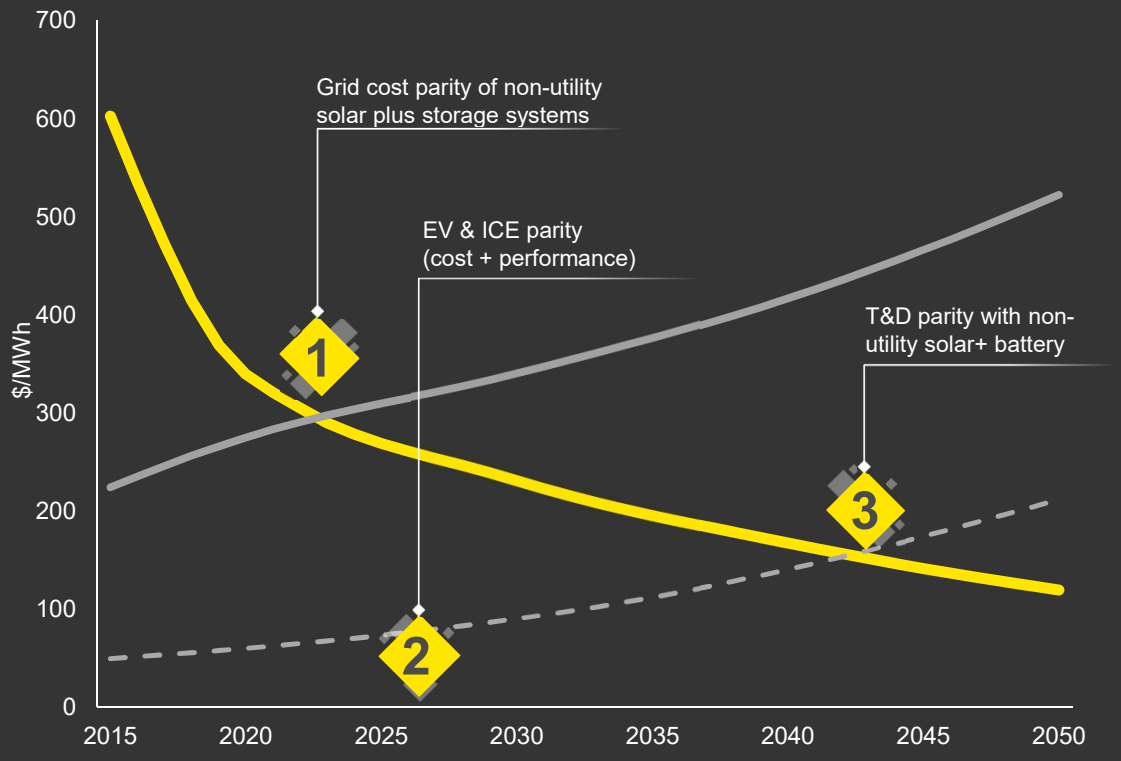
The digital energy market place

* Non-utility: [illegible] business customers producing electricity
** ICE: internal combustion engine

EY

The timing and order of the tipping points depends on the local context and varies widely: European example

European demopgraphics and unified policy setting have built momentum for rapid change in renewables adoption and transport



Illustrators[1]

Tipping point 1 is **5 years** away in Europe

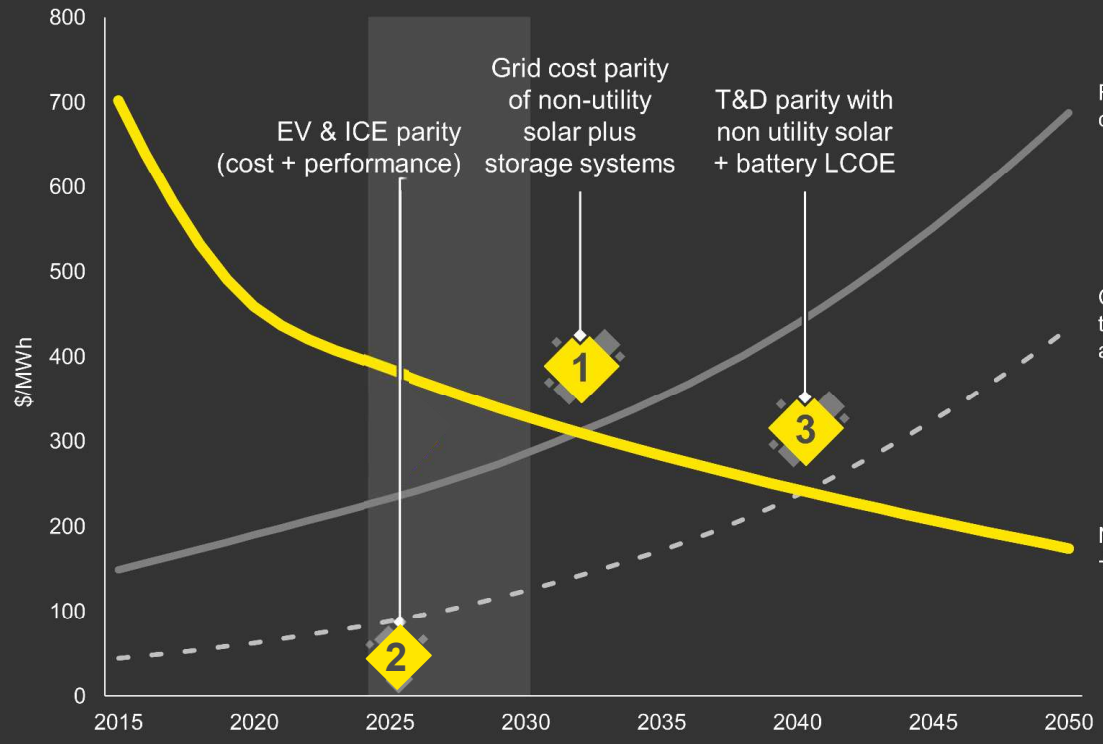
Tipping point 2 is **8 years** away in Europe

Tipping point 3 is **24 years** away in Europe

[1] Analysis is based on average profiles. In each geography, there will be segments of the customer base for whom the economics improve much sooner.

The timing and order of the tipping points depends on the local context and varies widely: Northeast US example

US Northeast: Tipping point 1 is occurring sooner than other regions due to drastic rise in retail and T&D price of electricity



Illustrators[1]

Tipping point 1 is **13 YEARS** away in US Northeast

Tipping point 2 is **7 YEARS** away in US Northeast

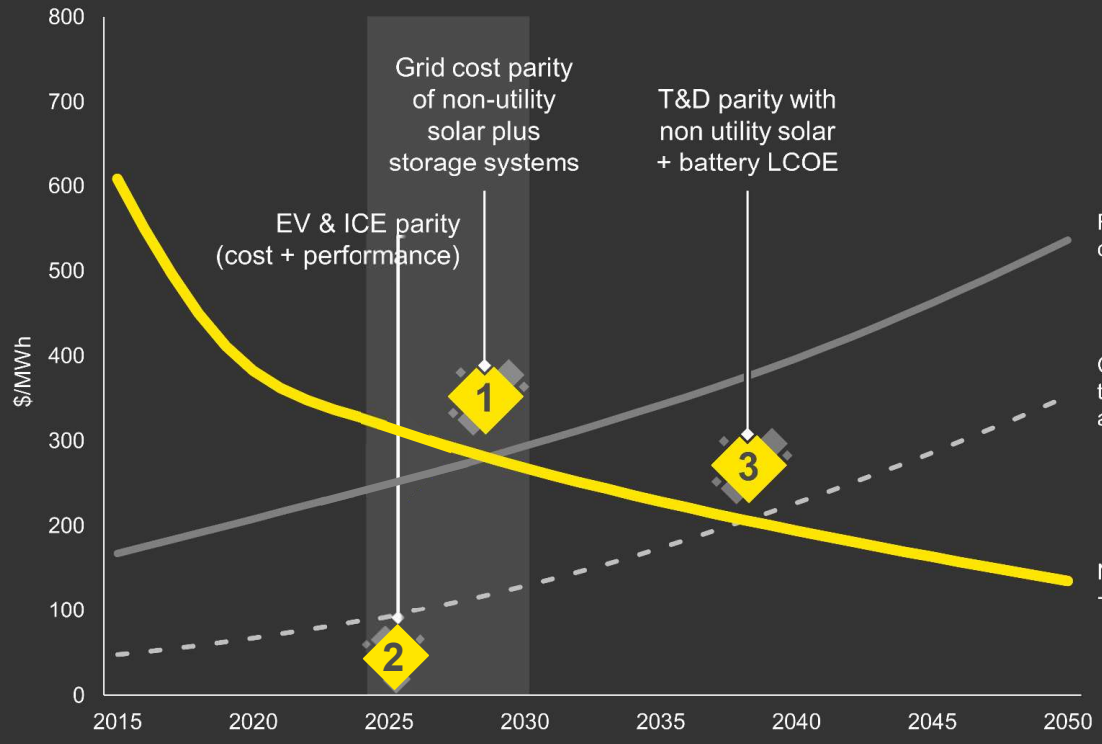
Tipping point 3 is **21 YEARS** away in US Northeast

Source: Utility impact model central scenario US Northeast – EY Analysis | [1] Analysis based on average profiles. In each geography there will be segments of the customer base for whom the economics improve much sooner

EY

The timing and order of each tipping point depends on the local context and varies widely: California example

California: The pace of change will be defined by growing solar, and strong initiatives in EVs and battery storage



Illustrators[1]

Tipping point 1 is **10 YEARS** away in California

Tipping point 2 is **7 YEARS** away in California

Tipping point 3 is **18 YEARS** away in California

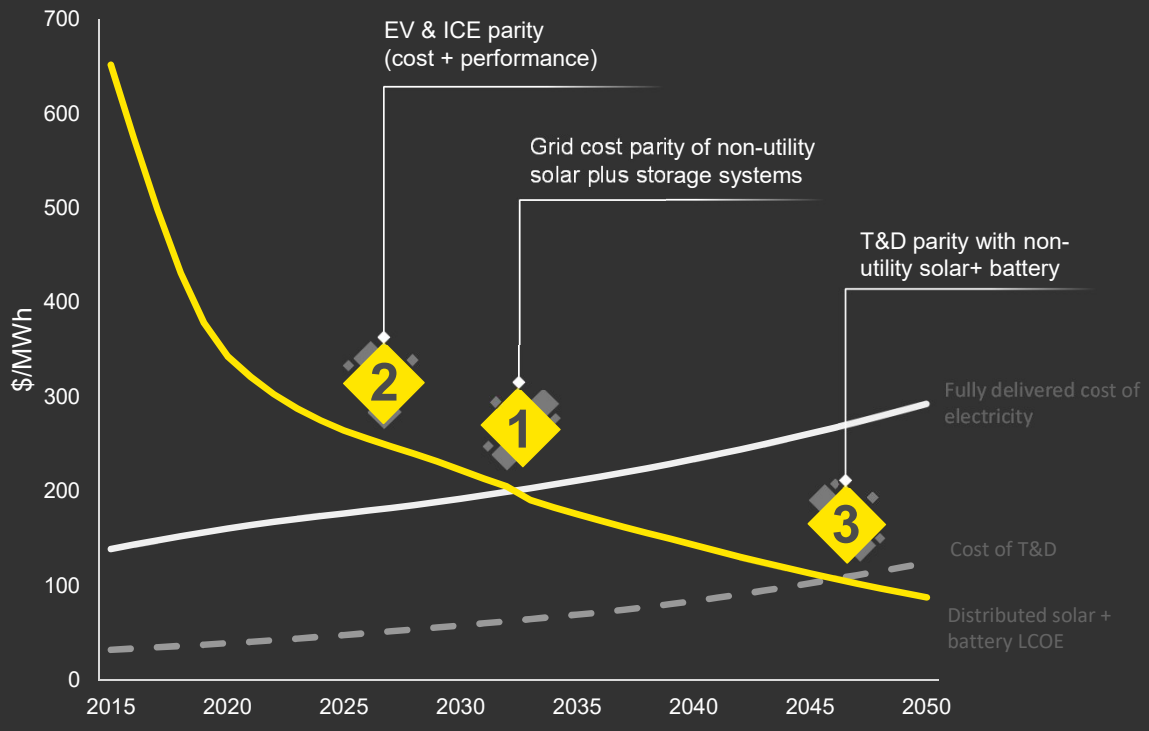
Source: Utility impact model central scenario US California– EY Analysis

[1] Analysis based on average profiles. In each geography there will be sgments of the customer base for whom the economics improve much sooner

EY

The timing and order of the tipping points depends on the local context and varies widely: Latin America example 1*

* includes Brazil, Colombia, Venezuela, Peru, Ecuador, Guatemala, Costa Rica, Panama, Uruguay, Paraguay, El Salvador, Nicaragua



Illustrators[1]

Tipping point 1 is **15 years** away in Latin America's renewables intensive countries

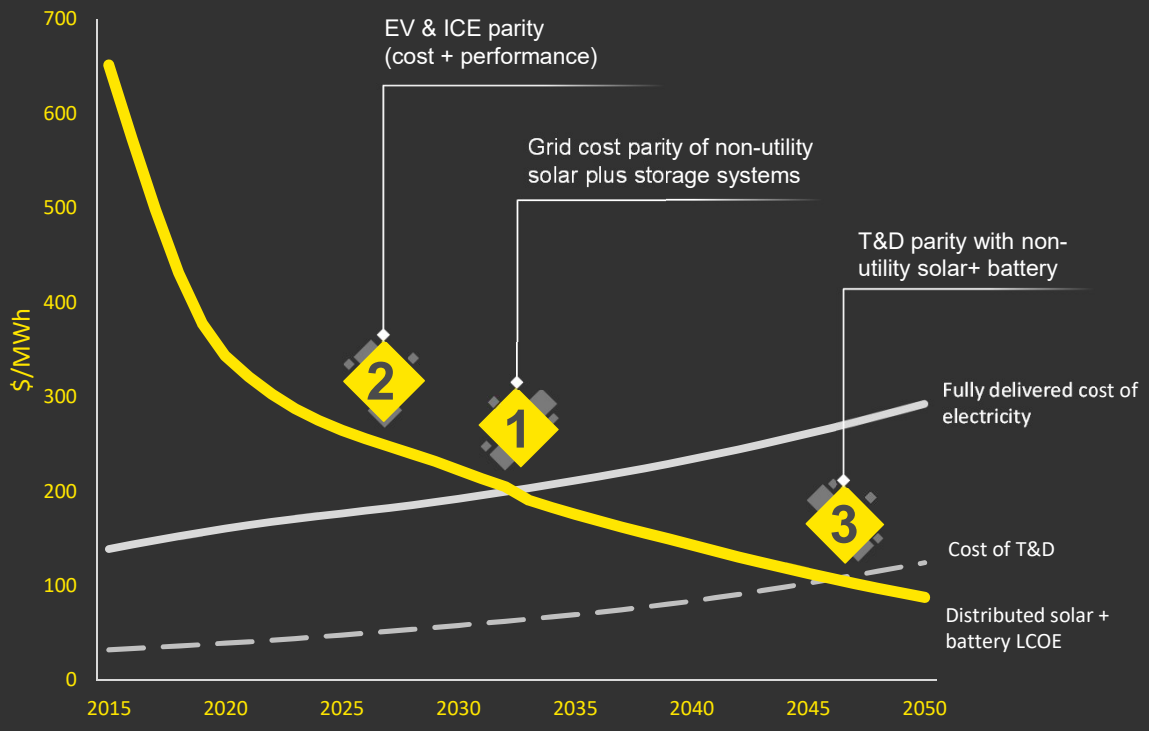
Tipping point 2 is **8 years** away

Tipping point 3 is **28 years** away

[1] Analysis is based on average profiles. In each geography, there will be segments of the customer base for whom the economics improve much sooner.

The timing and order of the tipping points depends on the local context and varies widely: Latin America example 2*

* includes Mexico, Argentina, Chile, Dominican Rep., Bolivia, Trinidad and Tobago, Honduras, Jamaica



Illustrators[1]

Tipping point 1 is **12 years** away in Latin America's fossil intensive countries

Tipping point 2 is **8 years** away

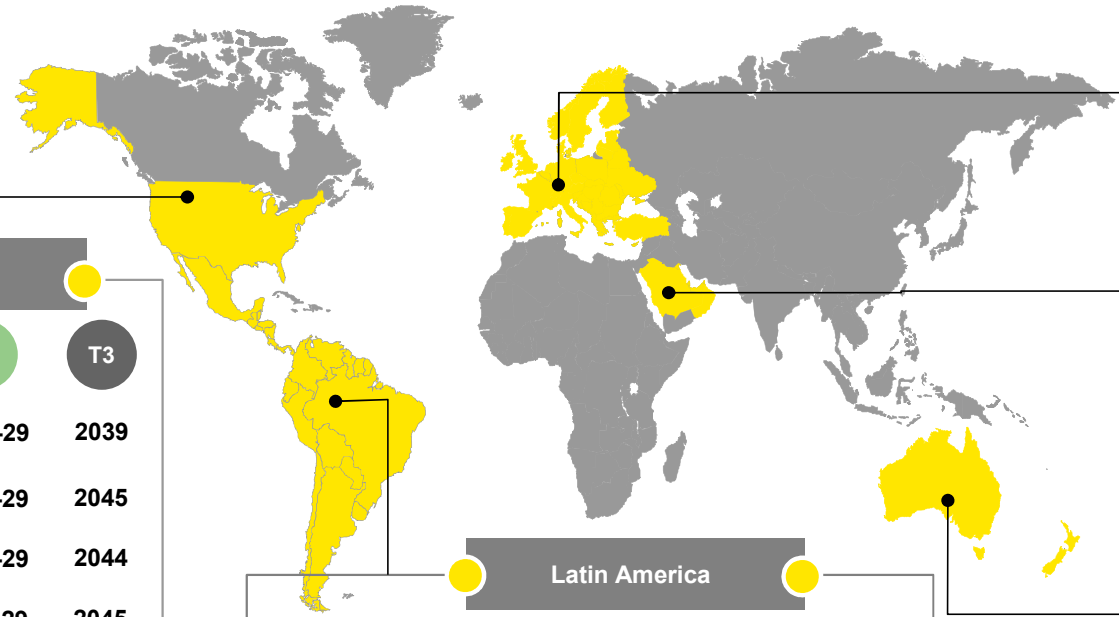
Tipping point 3 is **27 years** away

[1] Analysis is based on average profiles. In each geography, there will be segments of the customer base for whom the economics improve much sooner.

Colombia: scenarios and sensitivities: - very likely to drive earlier tipping points

Technology	Impact	Colombia status
Solar PV	>1 year	• Low Penetration, but UPME forecasts for it to reach between 5% and 8% by 2031. • CREG announced first electric power auction for utility-scale solar projects. • New incentives have also been introduced
Battery storage	6 months to 1 year	• US Trade and Development Agency has been active in supporting • EV batteries will also have 0% import duty till 2027
Electric vehicles (EVs)	6 months to 1 year	• In 2017, only 754 EVs were bought in Colombia, but import duties on EVs and hybrids have been reduced. • UPME launched a pilot program for 400k EVs
Smart meters	0 to 6 months	• CREG goal for penetration to reach 90% in urban areas and 50% in rural areas by 2030. • Smart meter penetration a $1.2b market opportunity (Northeast Group)
Fall in distributed solar LCOE	>1 year	• High electricity prices and declining costs for rooftop solar in addition to new incentives drive lower prices

Timelines for Tipping Points vary region to region. Our preliminary results for Latam have just been released



U.S.A.

	T1	T2	T3
Northeast	2031	2025-29	2039
West Coast	2034	2025-29	2045
Midwest	2036	2025-29	2044
ERCOT	2038	2025-29	2045
Southeast	2042	2025-29	>2050

Europe

T1	T2	T3
2022	2025-29	2042

GCC

T1	T2	T3
2036	2025-29	2044

Oceania

T1	T2	T3
2021	2025-29	2040

Latin America

	T1	T2	T3
Renewables intensive*	2033	2025-29	2046
Fossil fuel intensive**	2030	2025-29	2045

* includes Brazil, Colombia, Venezuela, Peru, Ecuador, Guatemala, Costa Rica, Panama, Uruguay, Paraguay, El Salvador, Nicaragua

** includes Mexico, Argentina, Chile, Dominican Rep., Bolivia, Trinidad and Tobago, Honduras, Jamaica

Source: Utility impact model central scenario - EY analysis

…and takes into account the combined effect of 10 core technologies that are critical to the electricity market

Delivery technologies

Distributed Solar PV
Smaller on-site solar systems producing energy that can be consumed independent of grid supply

Behind-the-meter battery storage
On-site batteries used to store electrical energy, including both stationary as well as EV batteries

Electric vehicles
Plug-in passenger EVs, including battery electrical vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs)

Microgrids
A group of distributed energy resources (DER) and electrical loads with clear network boundaries. Can operate in island-mode. Controllable as a single entity.

Home and building energy systems
Energy management systems that enable the most efficient and cost effective measurement, monitor, control, and optimization of energy consumption

Enabling technologies

Smart meters
Records consumption of electric energy in intervals of an hour or less and communicates the information back to the utility for monitoring and billing every day

Artificial intelligence
AI/cognitive systems that formulate possible answers and automatically adapt based on available evidence and training by ingesting vast amounts of data

Grid edge technologies
Includes devices, such as syncrophasers/smart grids, which helps record, monitor, control and optimize energy distribution

Cloud
Defined by public cloud sharing of electric utility spending on software, server and storage.

Peer-2-peer energy exchange
Technology which helps prosumers to exchange excess electricity with other consumers

The model is designed to incorporate both the reciprocal interactions of these technologies and their effect on the demand for electricity, and the cost of generating, distributing and selling electricity

These three tipping points will be felt across ALL functions and by ALL stakeholders

Corp Development

"All the targets in the market seem over-valued"

Operations

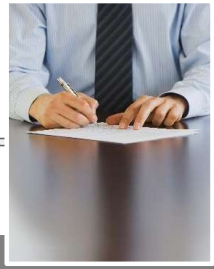
"How do we integrate smart technology to manage system peaks?"

Customers

"Why are rates rising again and so fast?"

Corporate Strategy

"Are we fighting macro trends or are we leading them?"



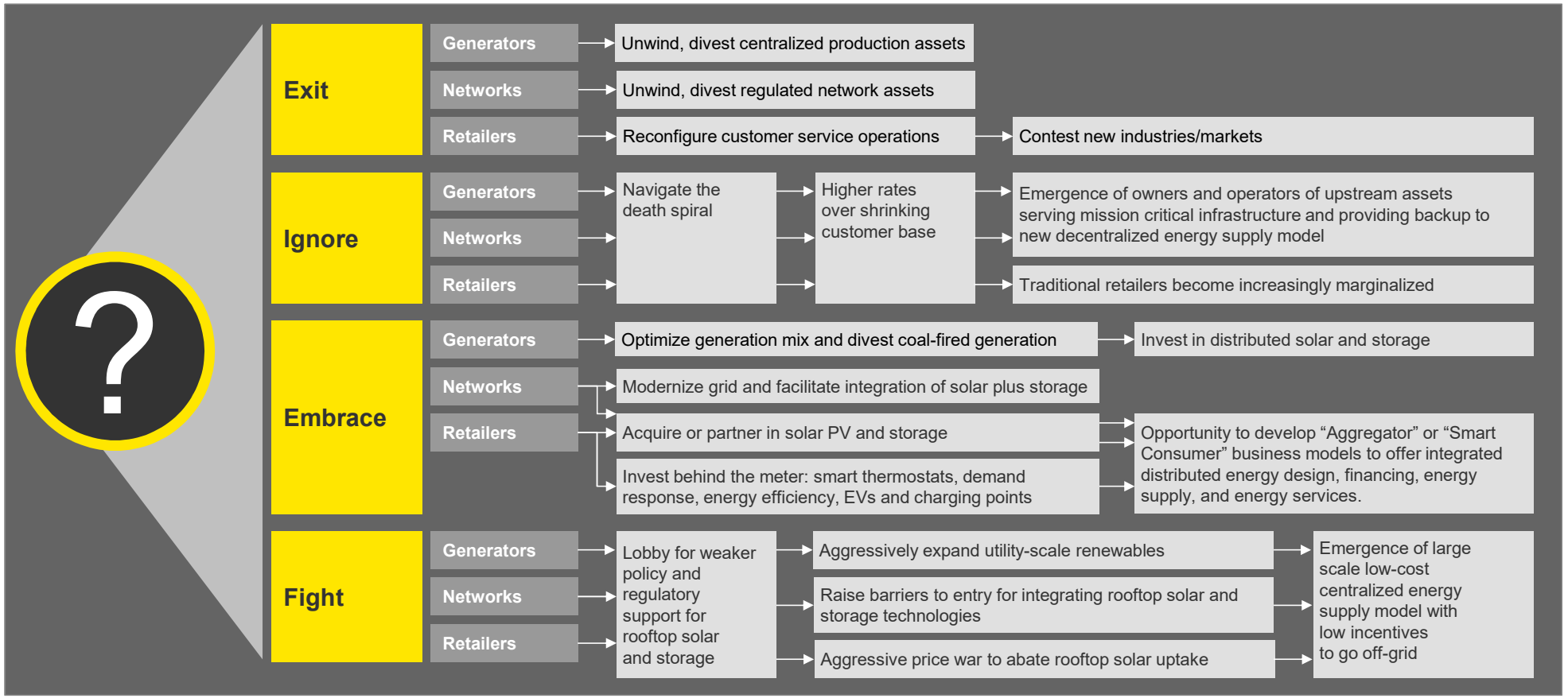
Regulation

"Integrating wholesale markets with distribution and retail markets is complex to coordinate"

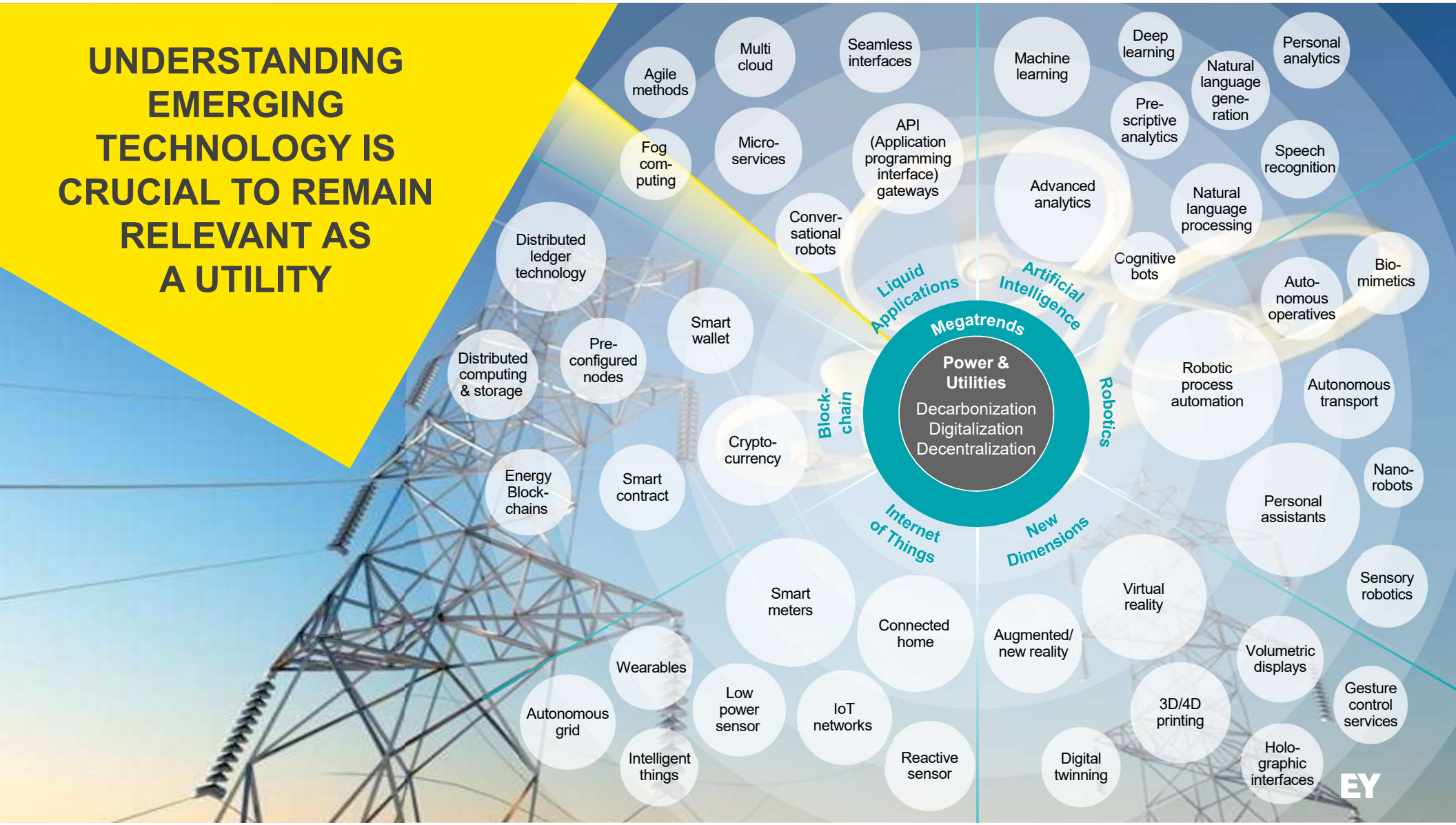
Investors/Creditors

"Stranded assets will weaken our balance sheet and compromise our growth program"

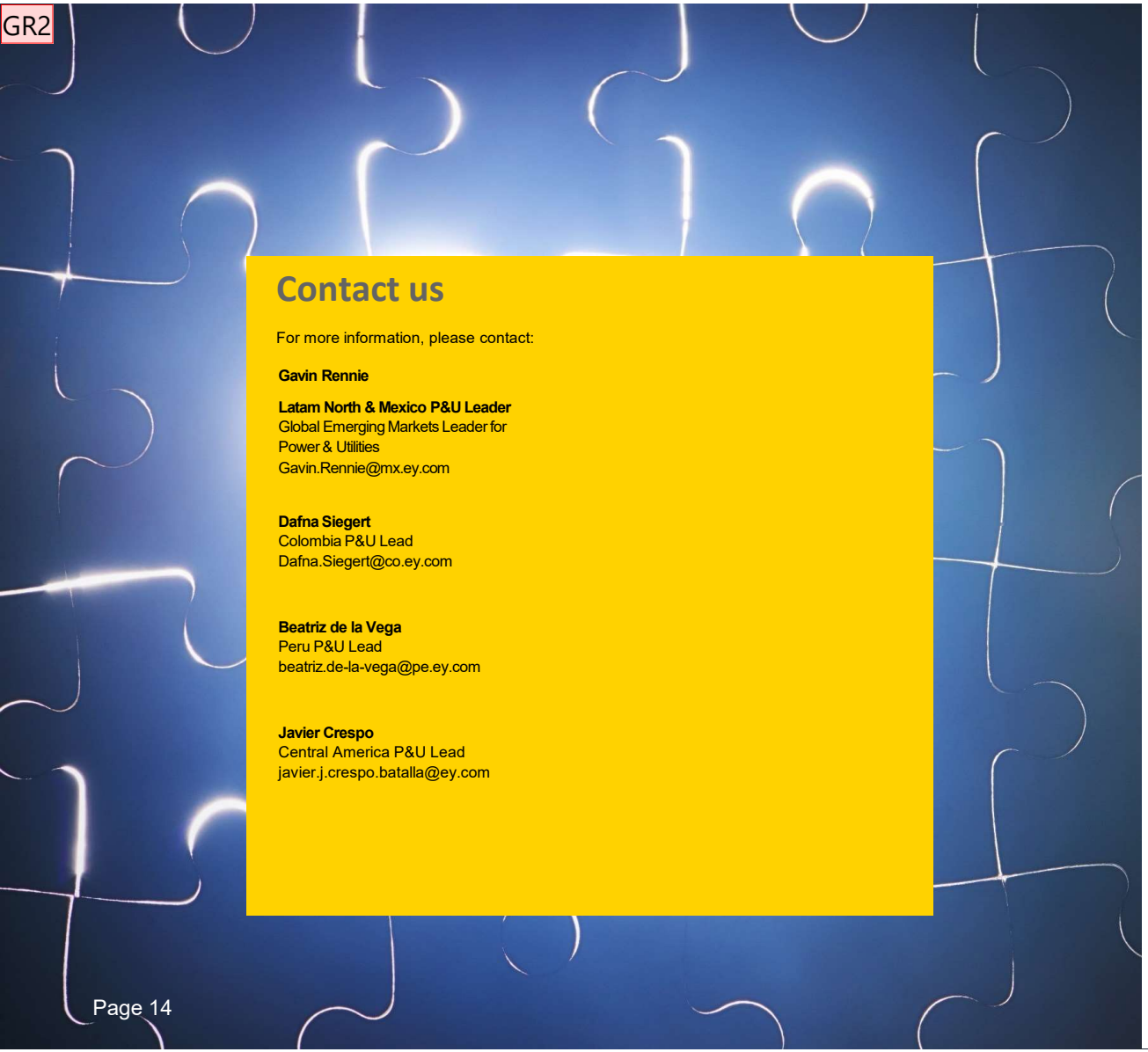
Understanding the three tipping points will reduce risks and create opportunities



UNDERSTANDING EMERGING TECHNOLOGY IS CRUCIAL TO REMAIN RELEVANT AS A UTILITY



GR2



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Diapositiva 14

GR2 This needs to have a different set of contacts. I have edited the contacts direct.
Gavin Rennie; 30/10/2018