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Capturing the value of renewable energy

How technology innovation helps you drive margin

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The background of the slide features a large-scale renewable energy installation. In the foreground and middle ground, there are extensive rows of solar panels mounted on metal frames, stretching across a flat landscape. In the background, several wind turbines are visible against a hazy, light-colored sky. The overall image has a blue and green color palette, giving it a clean, modern feel.

The market opportunity in renewable energy

The roadmap of the energy transition in dollars

Key technology is ready to deploy

Technologies that will change the global energy system will be deployed on a large scale the coming years.

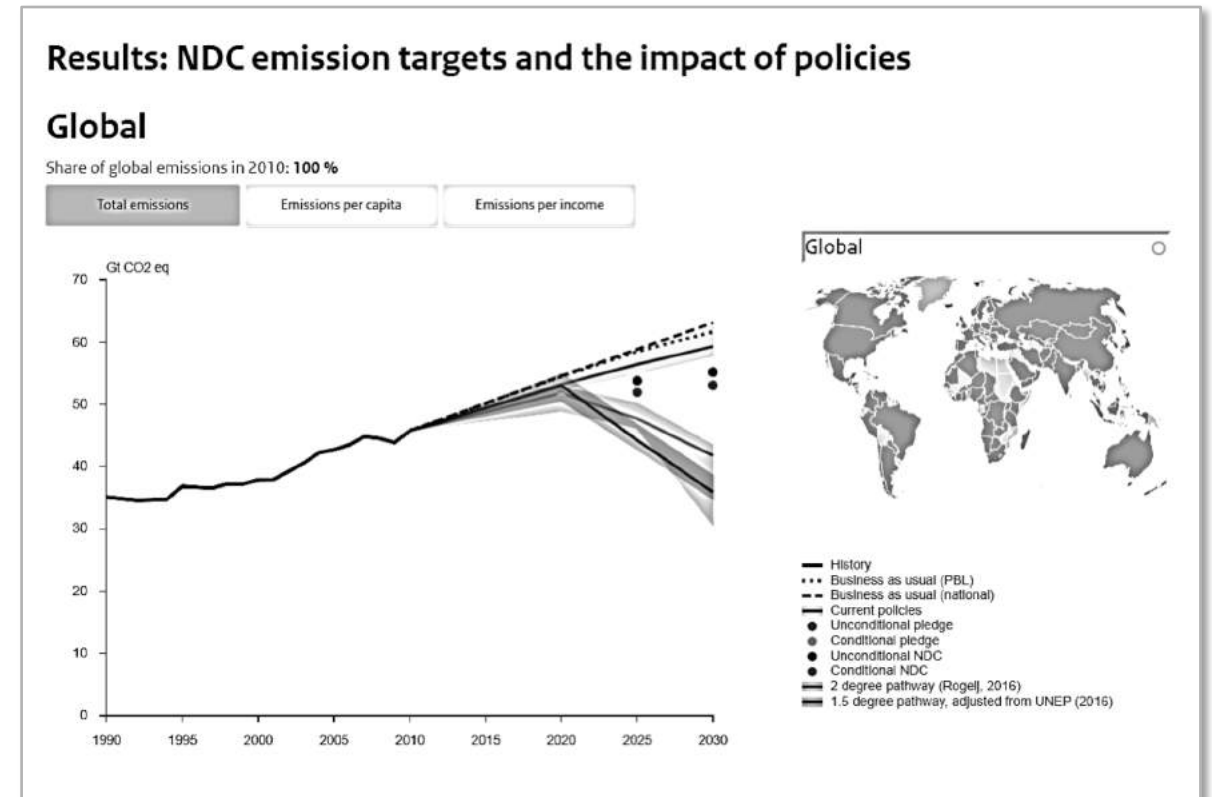
They can decrease our energy need and our need for combustion by at least 50%.

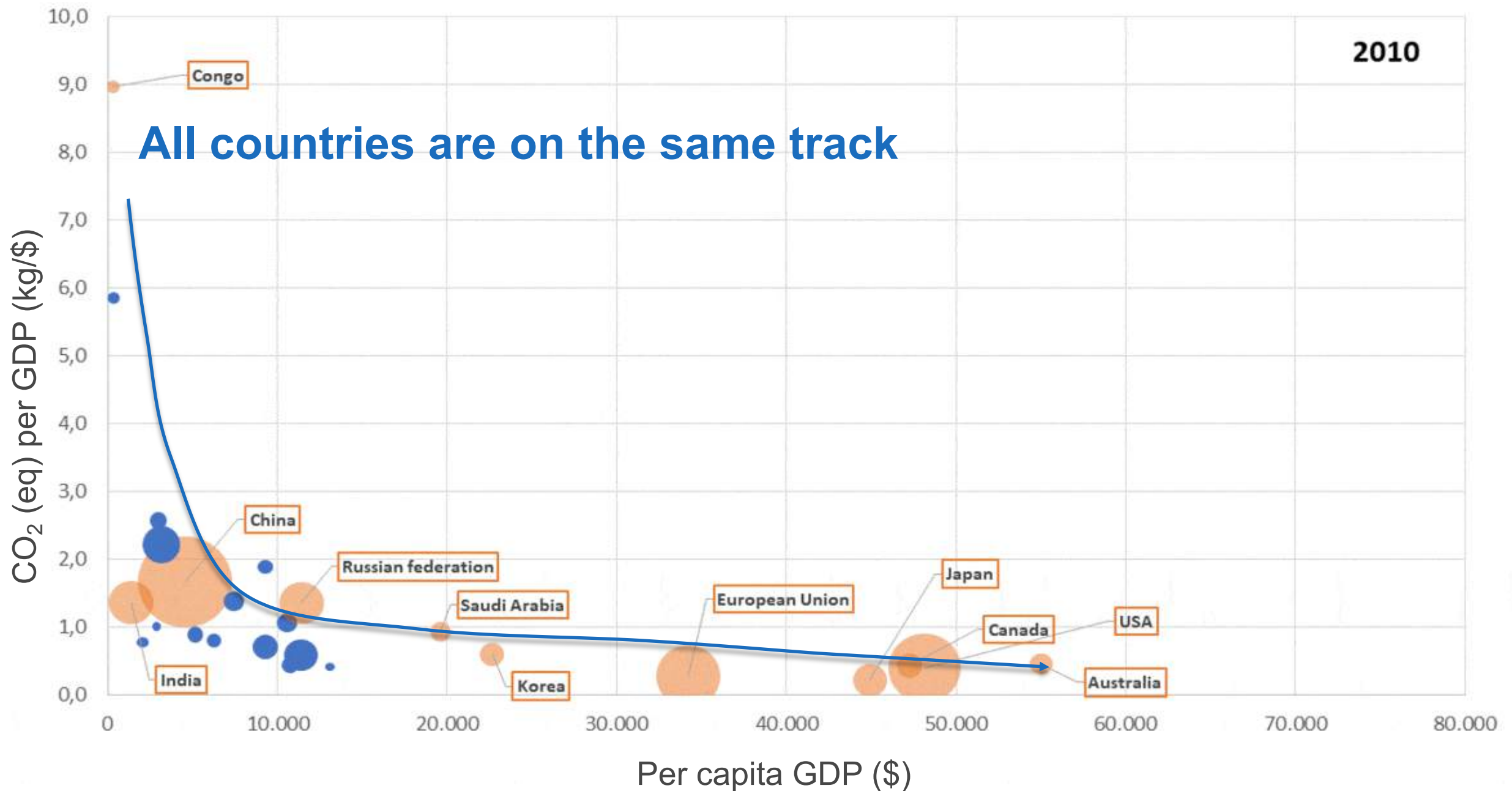
As NDC's of COP-21 materialize, the roadmap takes shape

How COP-21 works

- Countries need to submit plans
- NDC: **N**ationally **D**efined **C**ontribution
- Most plans are in now, at least until 2030
- Acceleration will need to happen post 2030

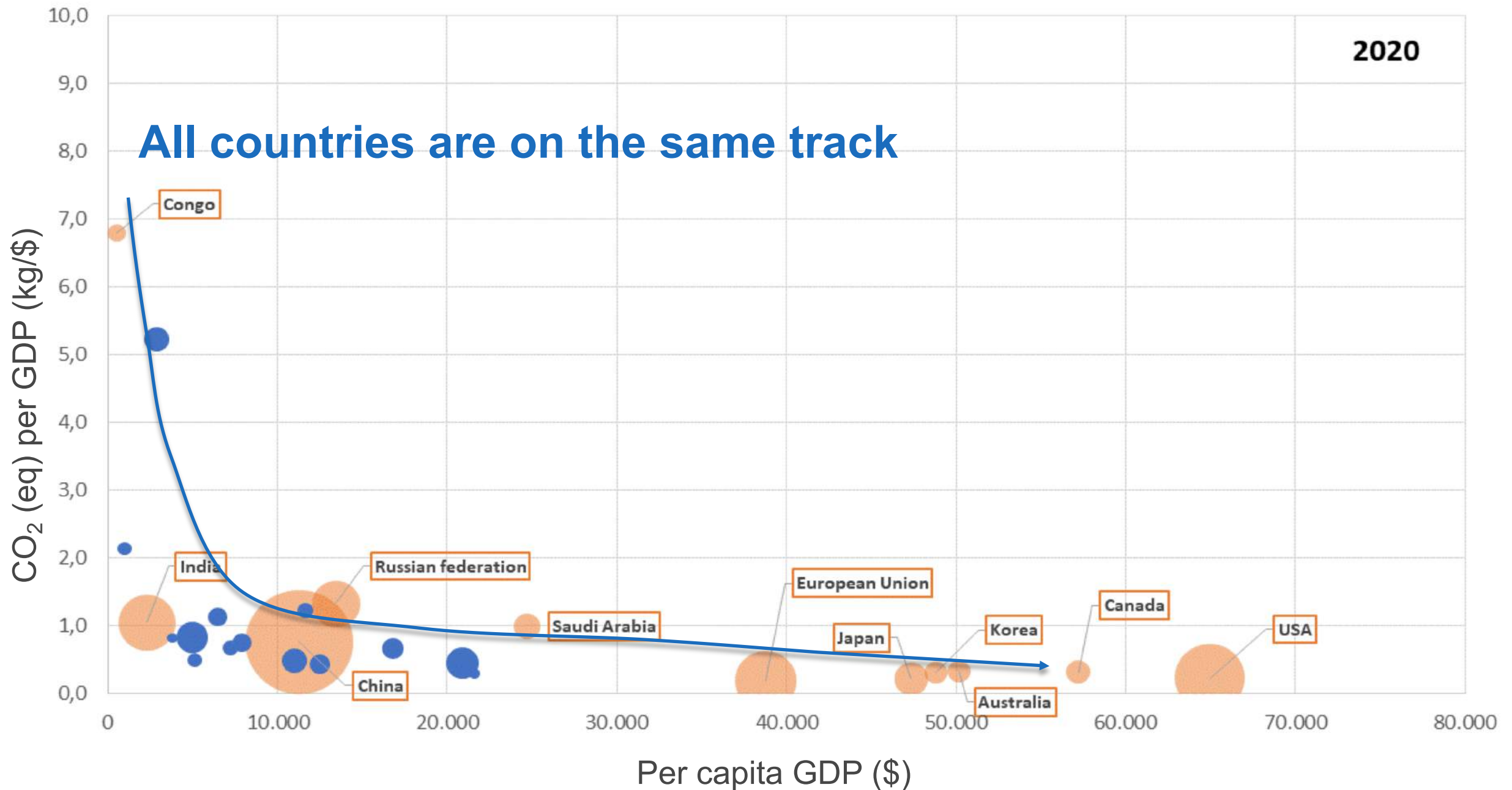
Take a look yourself, these people keep track: <http://themasites.pbl.nl/climate-ndc-policies-tool/>

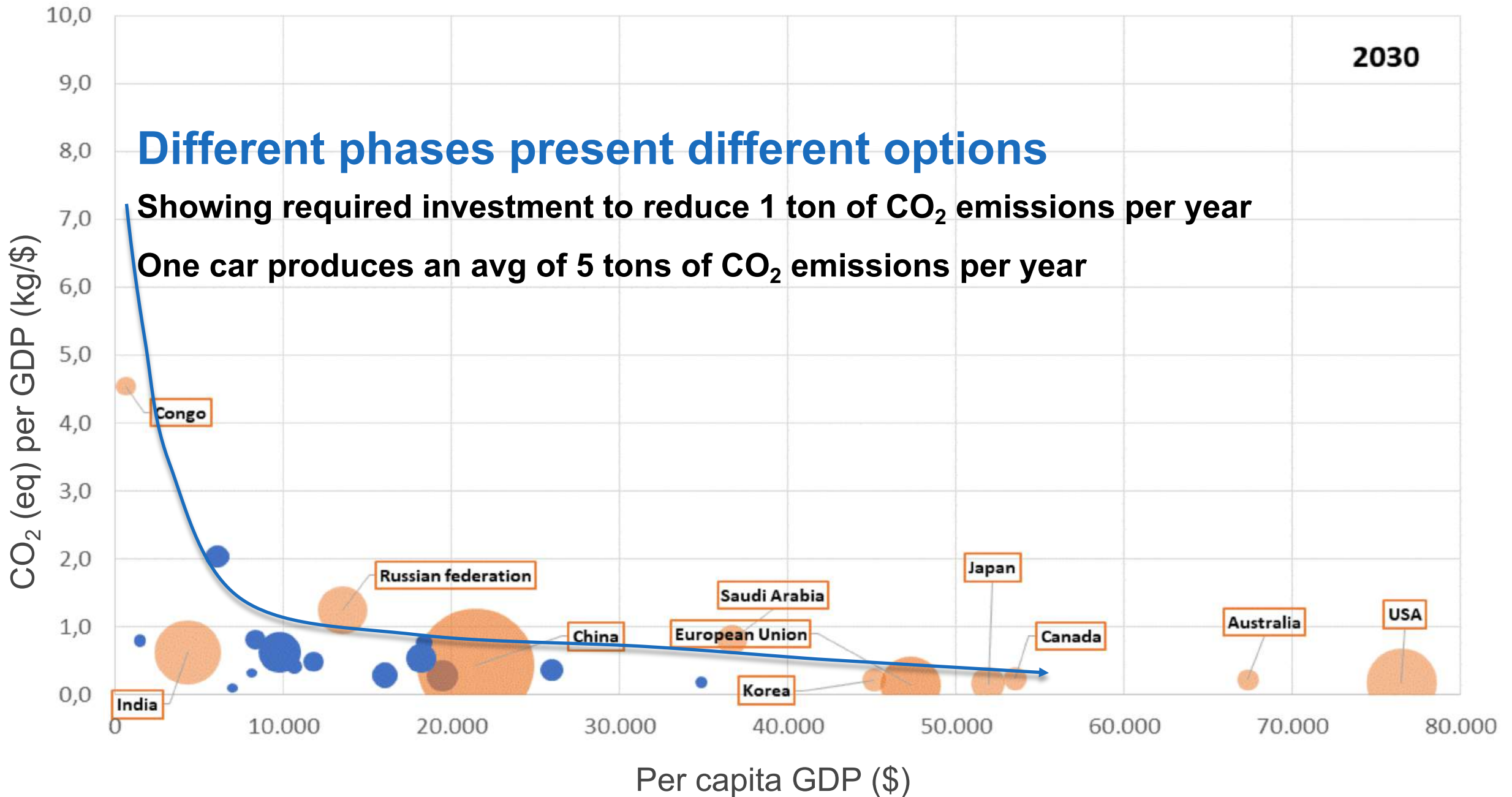


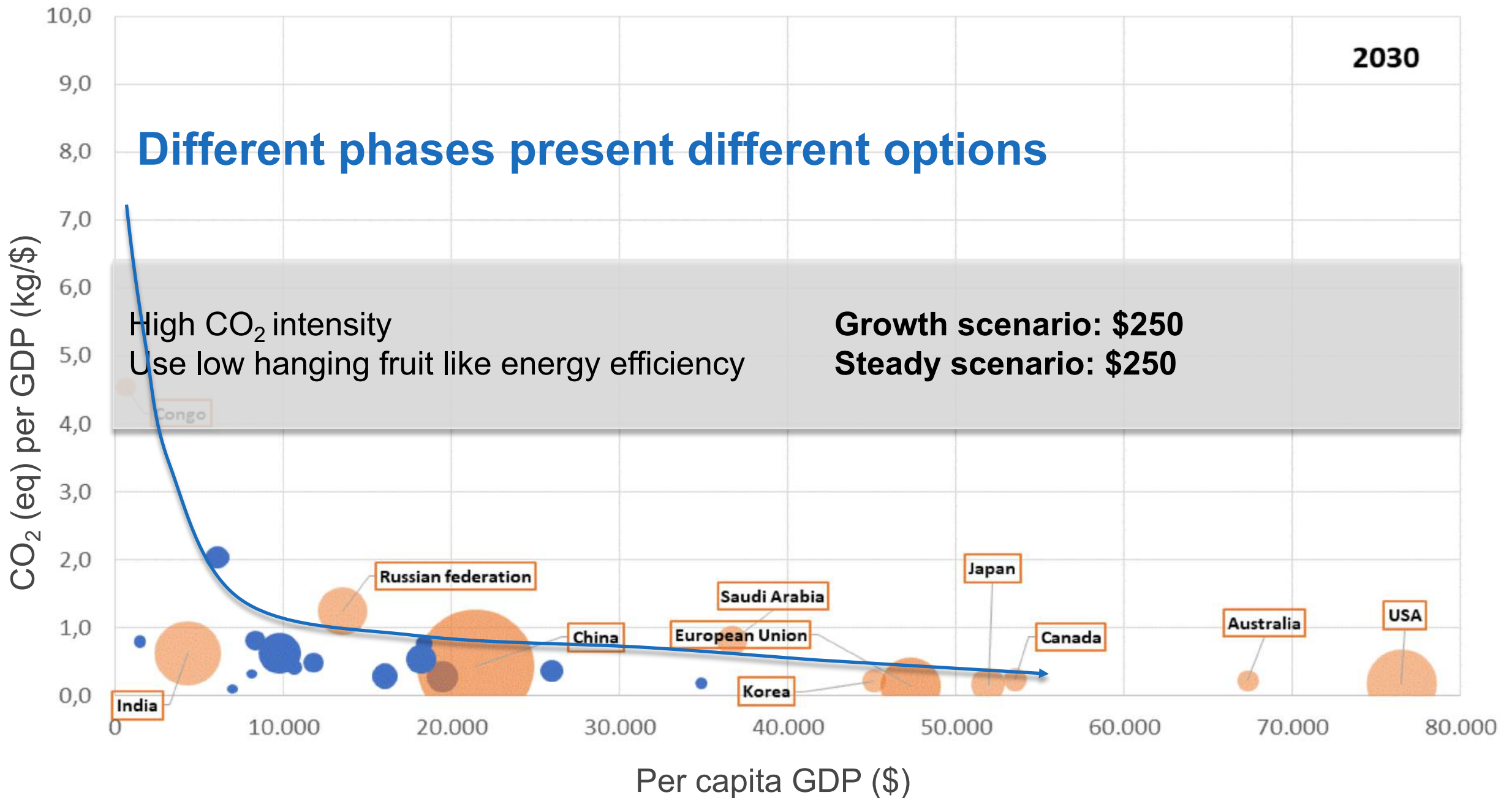


2020

All countries are on the same track







Digging Deeper into High CO₂ Intensity:

Use low hanging fruit like energy efficiency

ENERGY EFFICIENCY TECHNOLOGIES

- Advanced diagnostics
- Energy management systems
- Waste heat recovery
- Heat exchanger technology
- Advanced separation technology

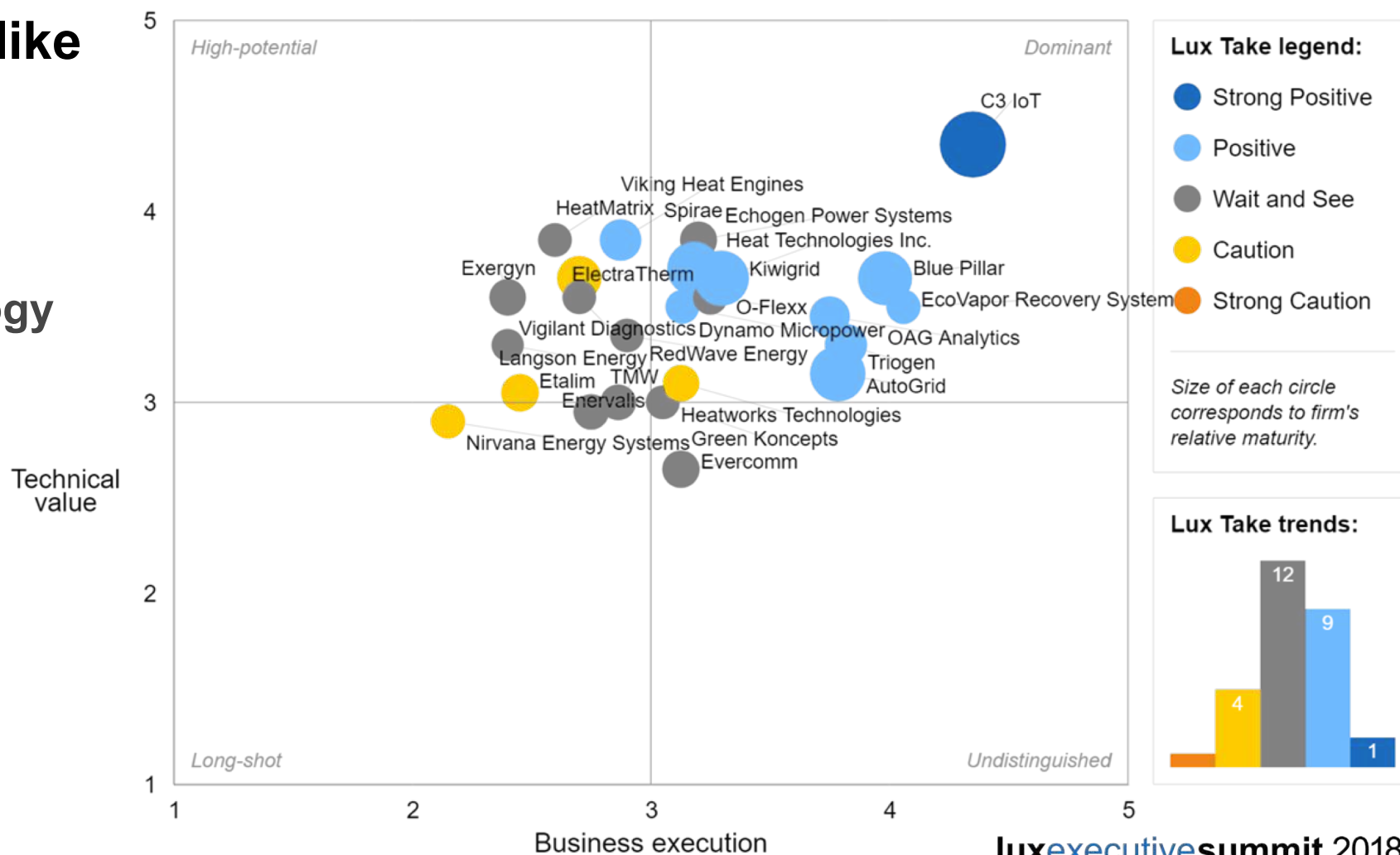


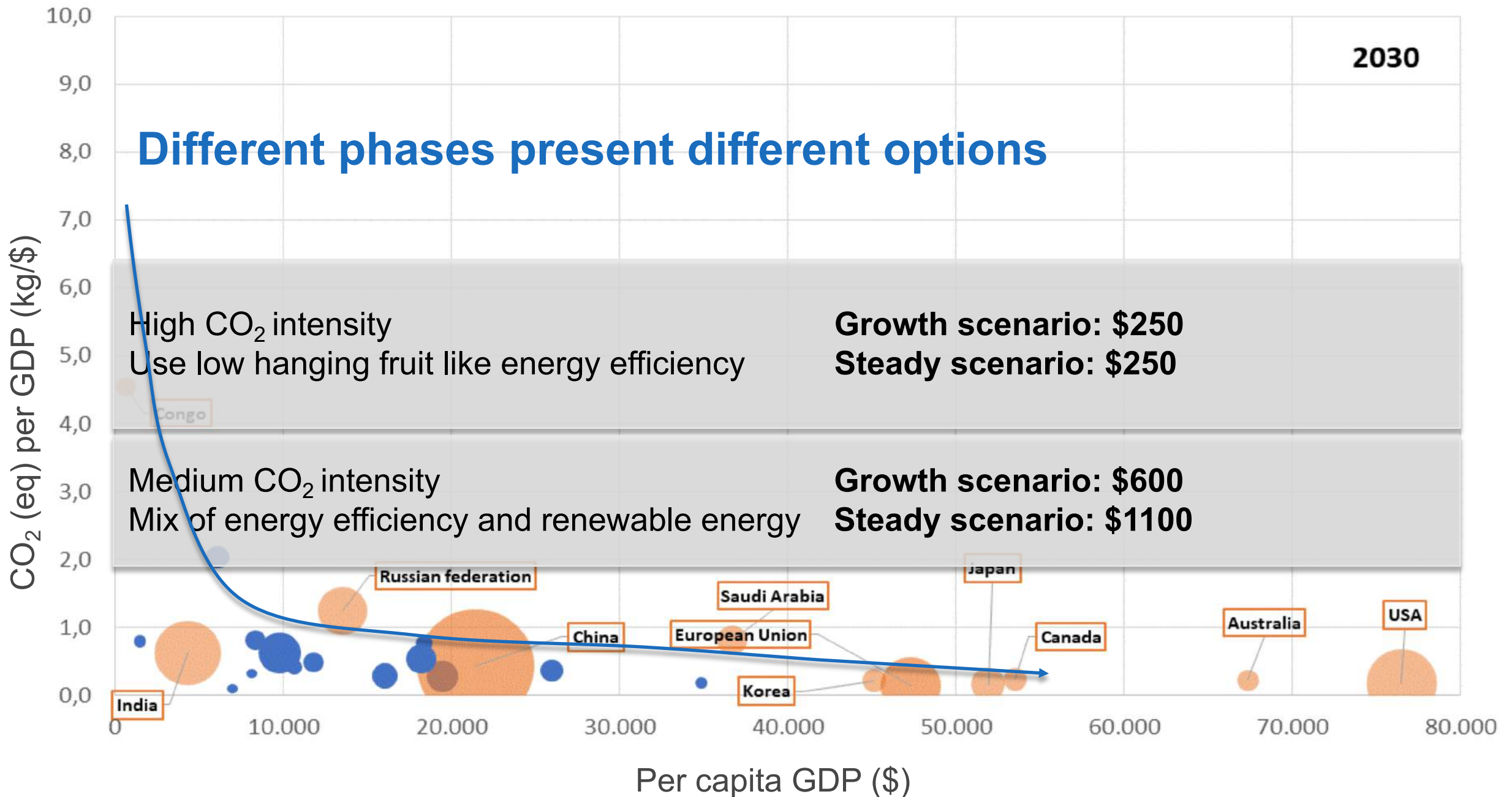
Digging Deeper into High CO₂ Intensity:

Use low hanging fruit like energy efficiency

LUX INNOVATION GRID:

Energy efficiency technology start-ups



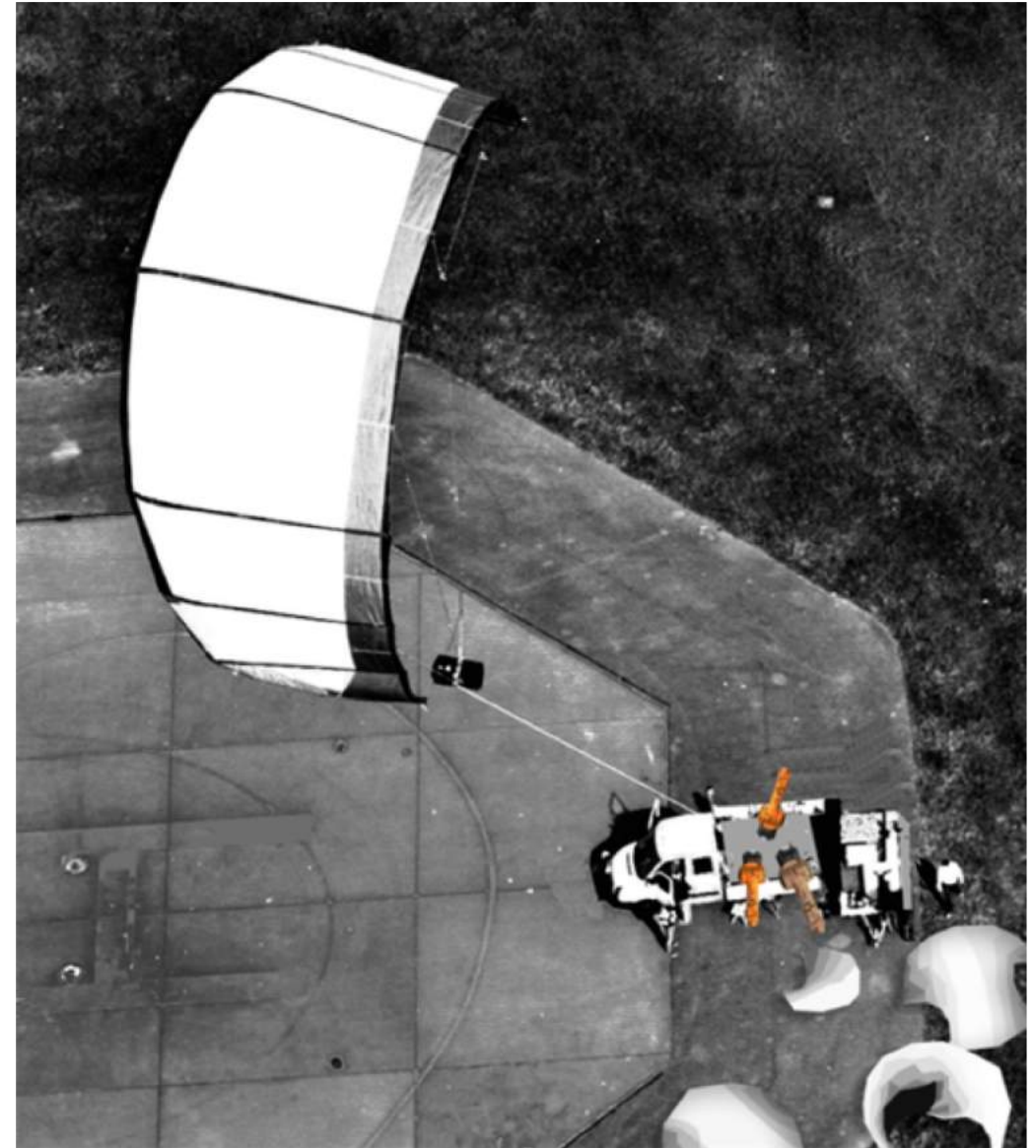


Digging Deeper into Medium CO₂ Intensity:

**Mix of energy efficiency
and renewable energy**

RENEWABLE ENERGY TECHNOLOGIES

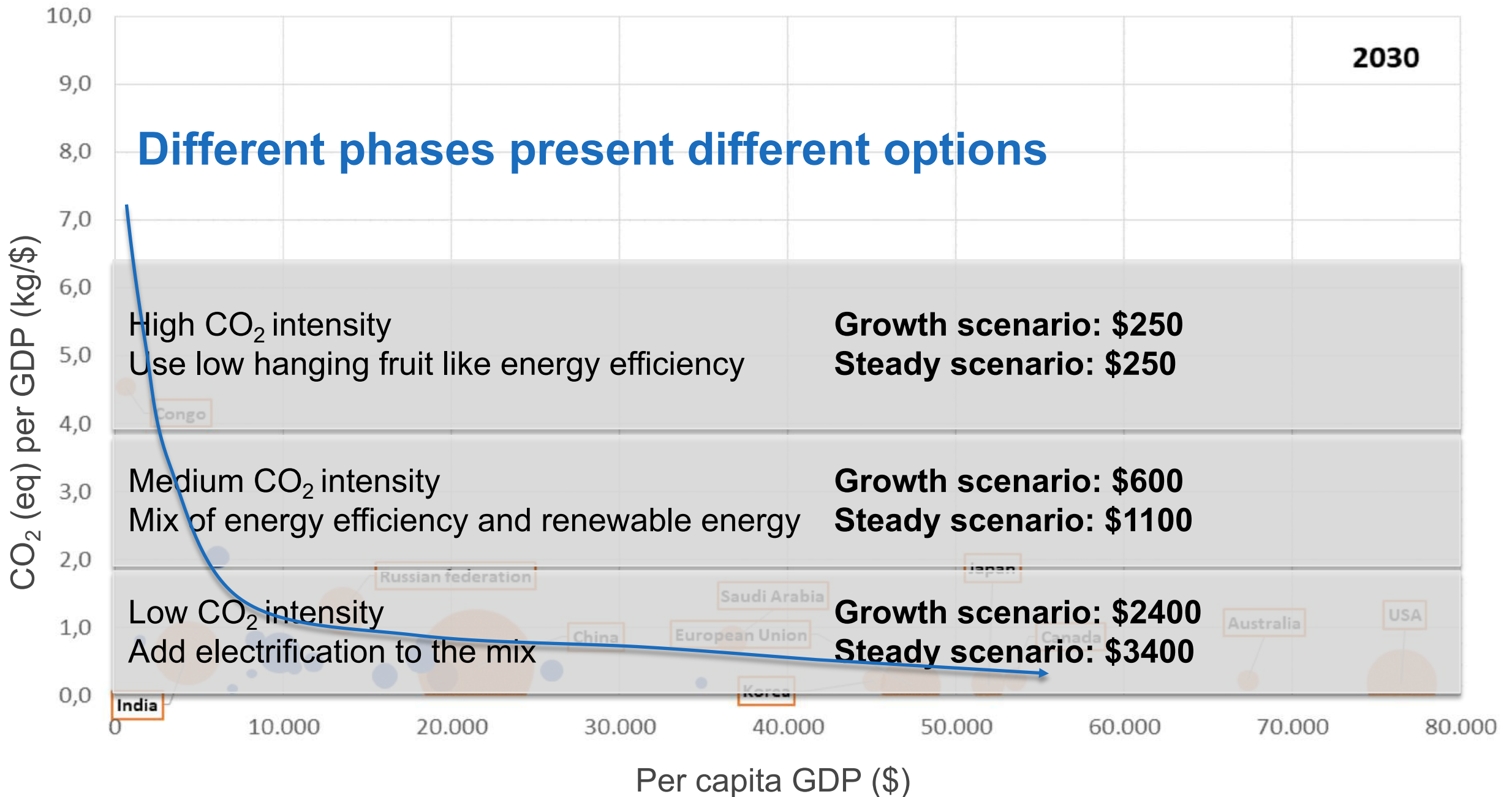
- Large established players
- Very active innovation
- New generation wind and solar



Mix of energy efficiency and renewable energy

Renewable energy technology start-ups



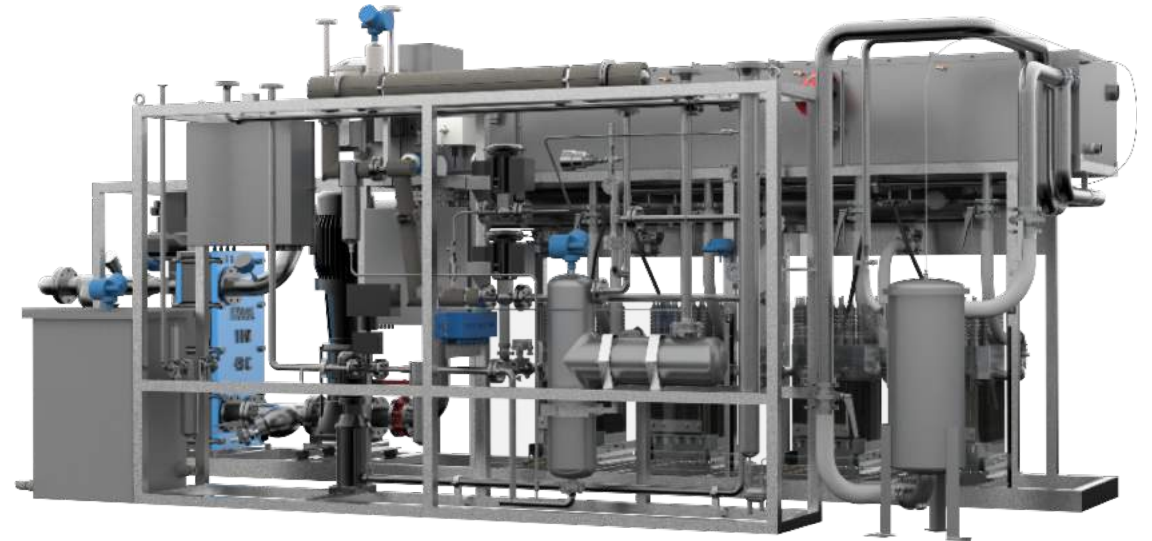


Digging Deeper into Low CO₂ Intensity:

Add electrification to the mix

ELECTRIFICATION TECHNOLOGIES

- Field is emerging
- Electric vehicles
- In industry: low temperature steam first
- Electrochemistry rapidly evolving

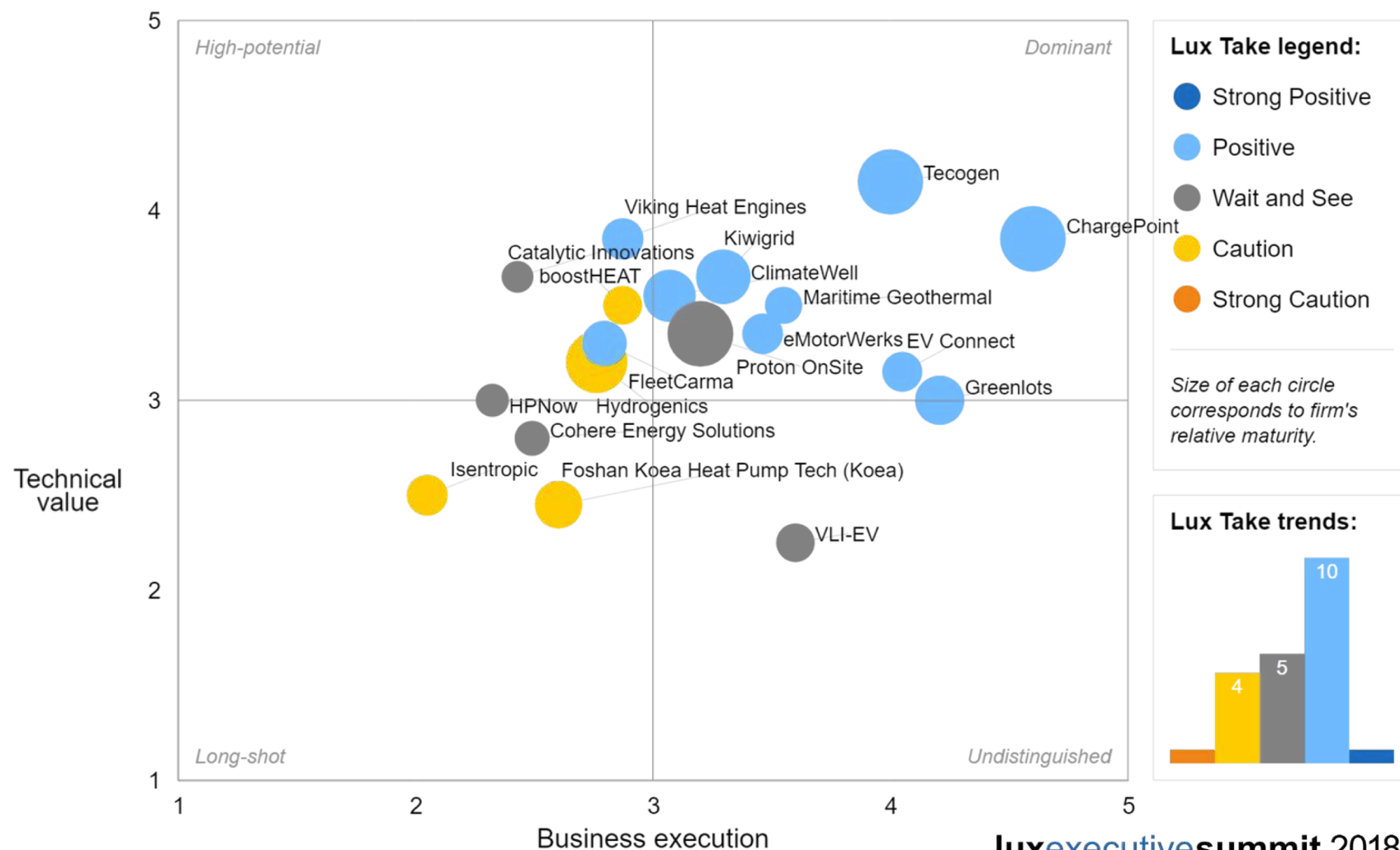


Digging Deeper into Low CO₂ Intensity:

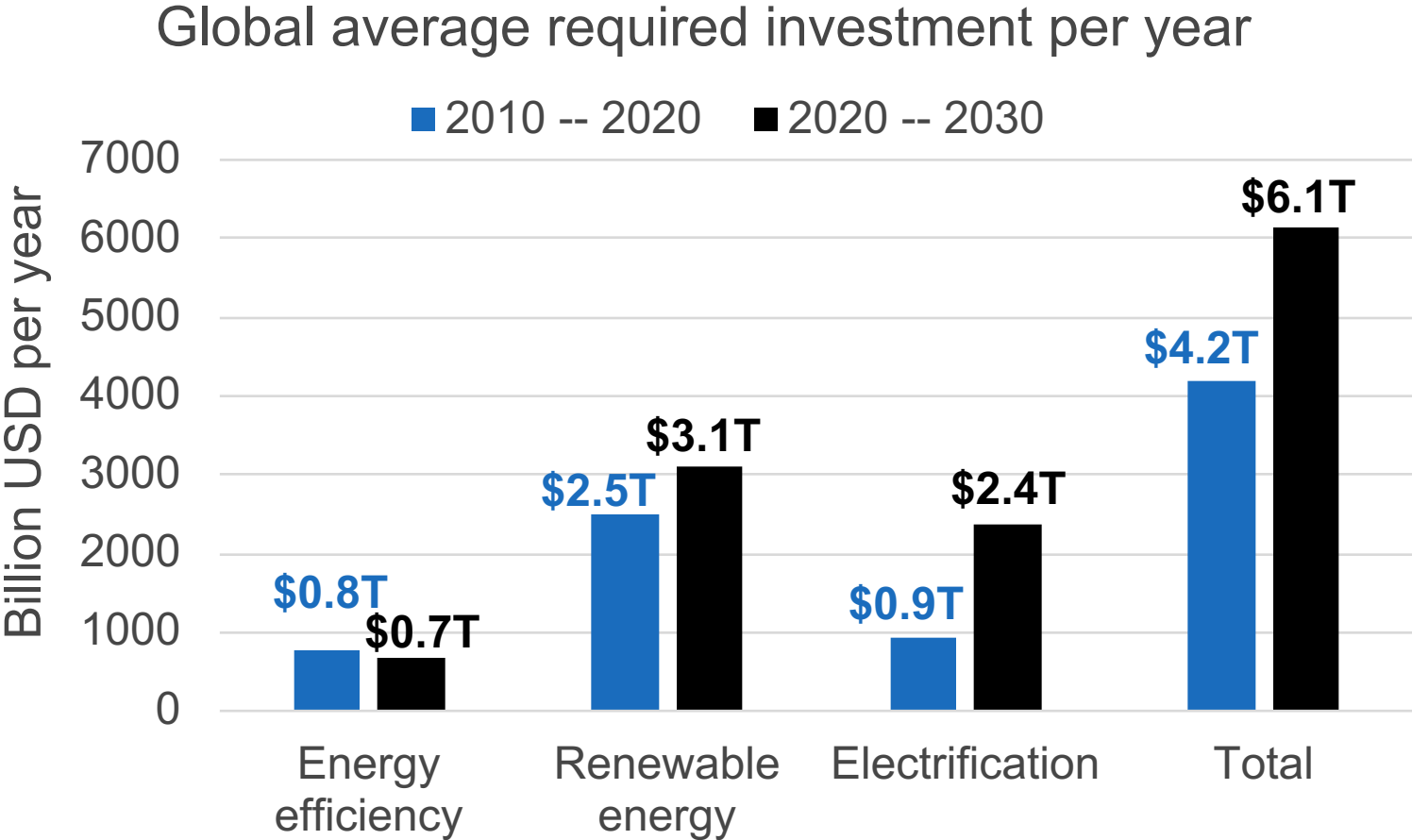
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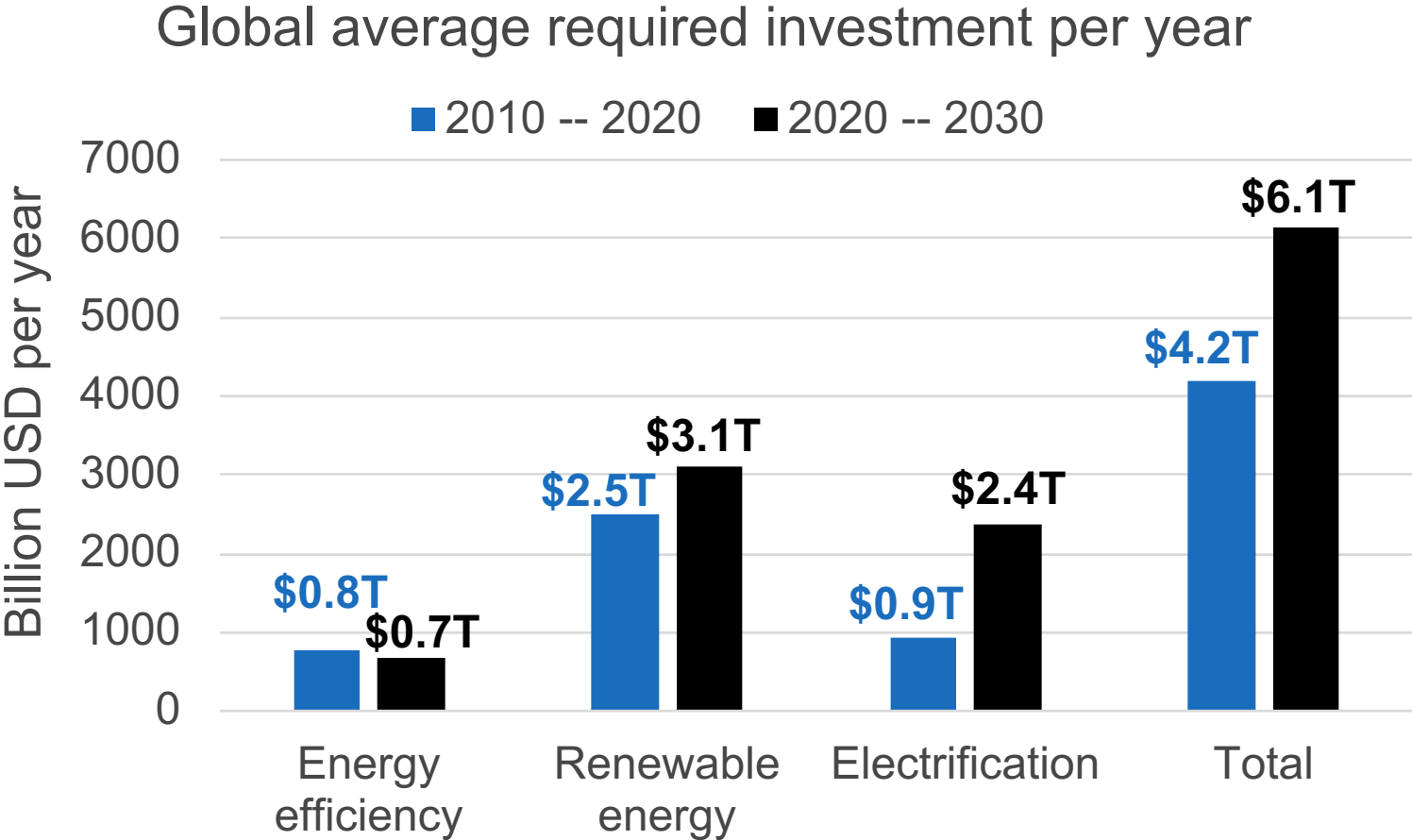
Electrification technology start-ups



The roadmap defines a multi-trillion dollar market



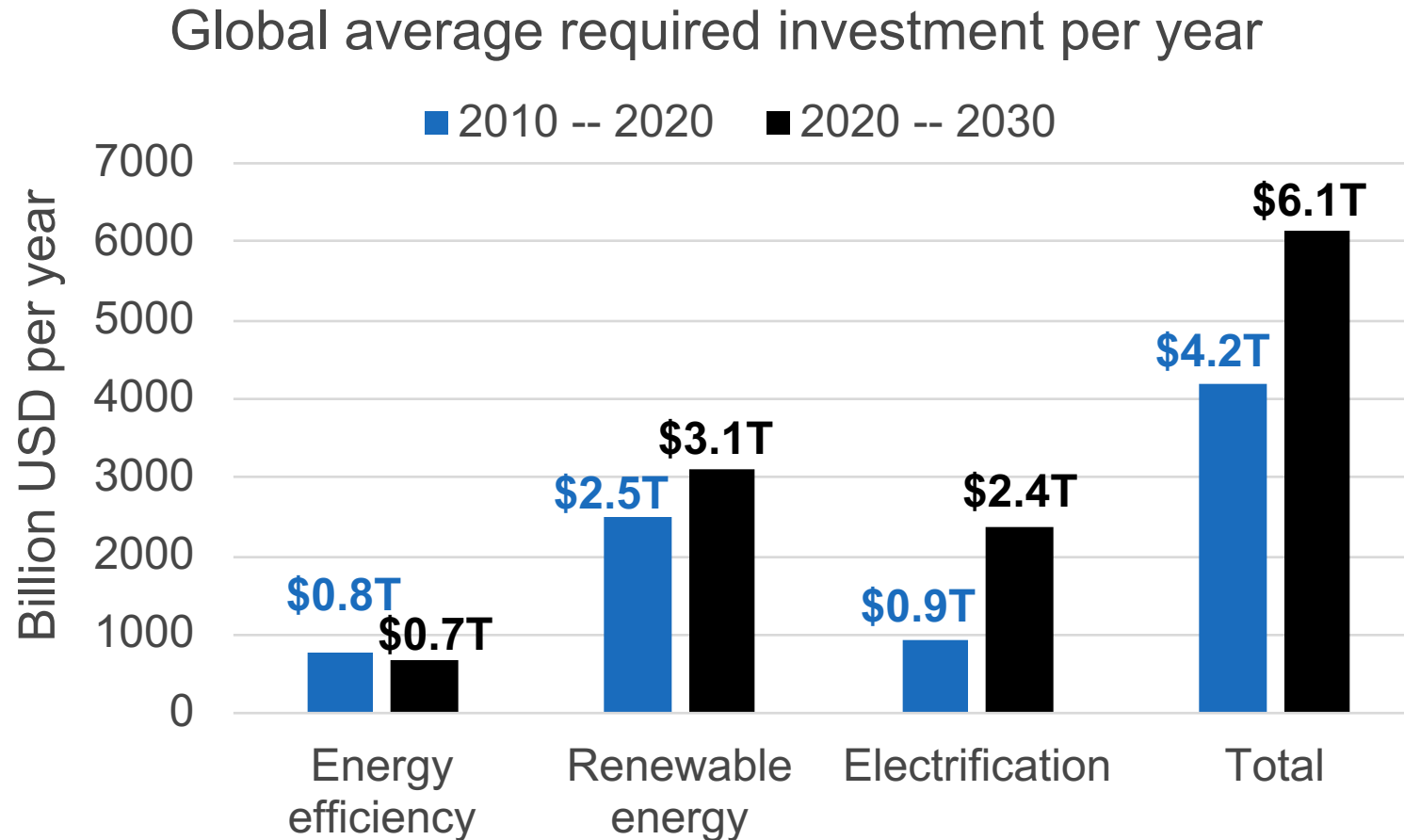
The roadmap defines a multi-trillion dollar market



About 3% of global GDP

Varies by country; between 0.5% and 13% of GDP

The roadmap defines a multi-trillion dollar market

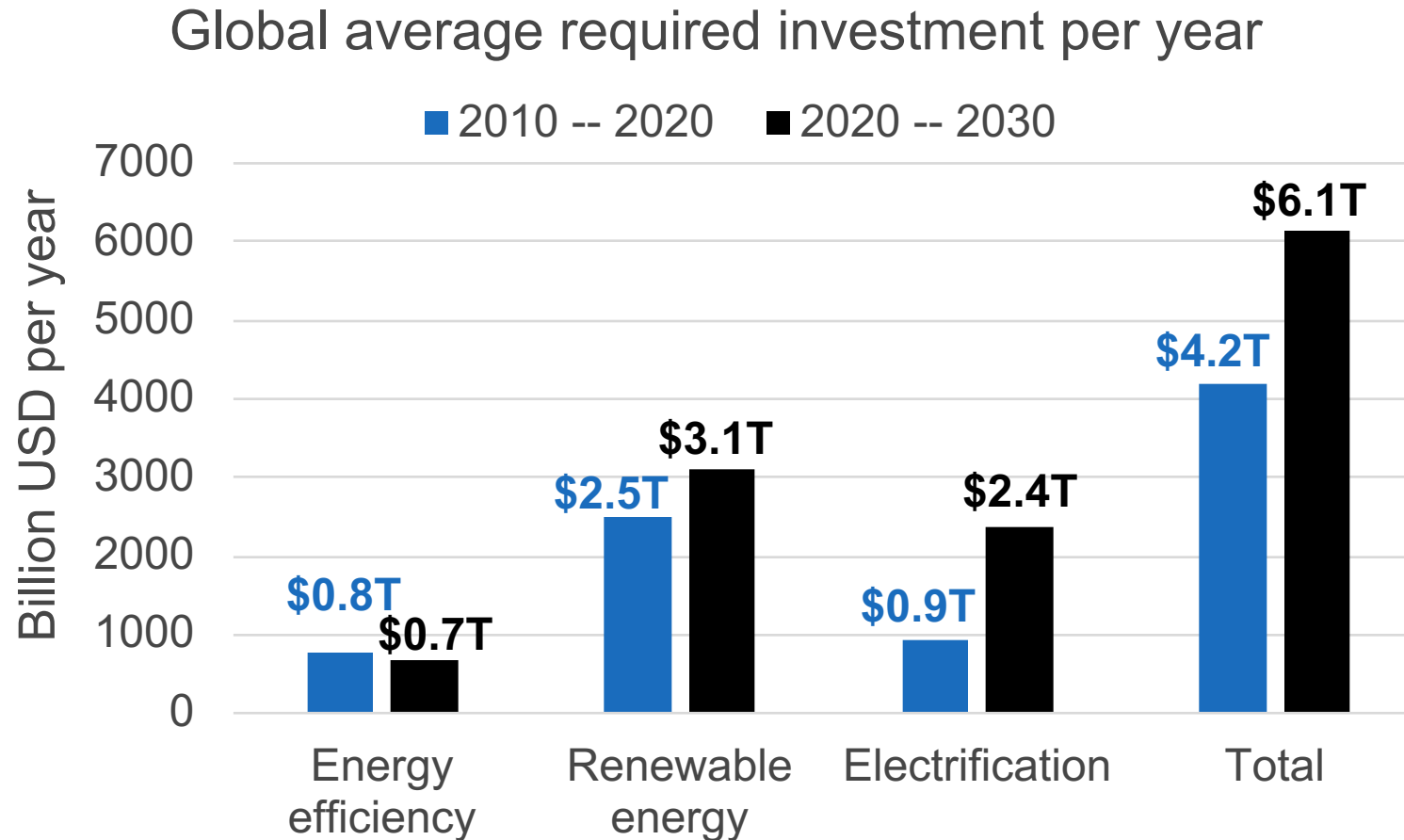


About 3% of global GDP

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The roadmap defines a multi-trillion dollar market



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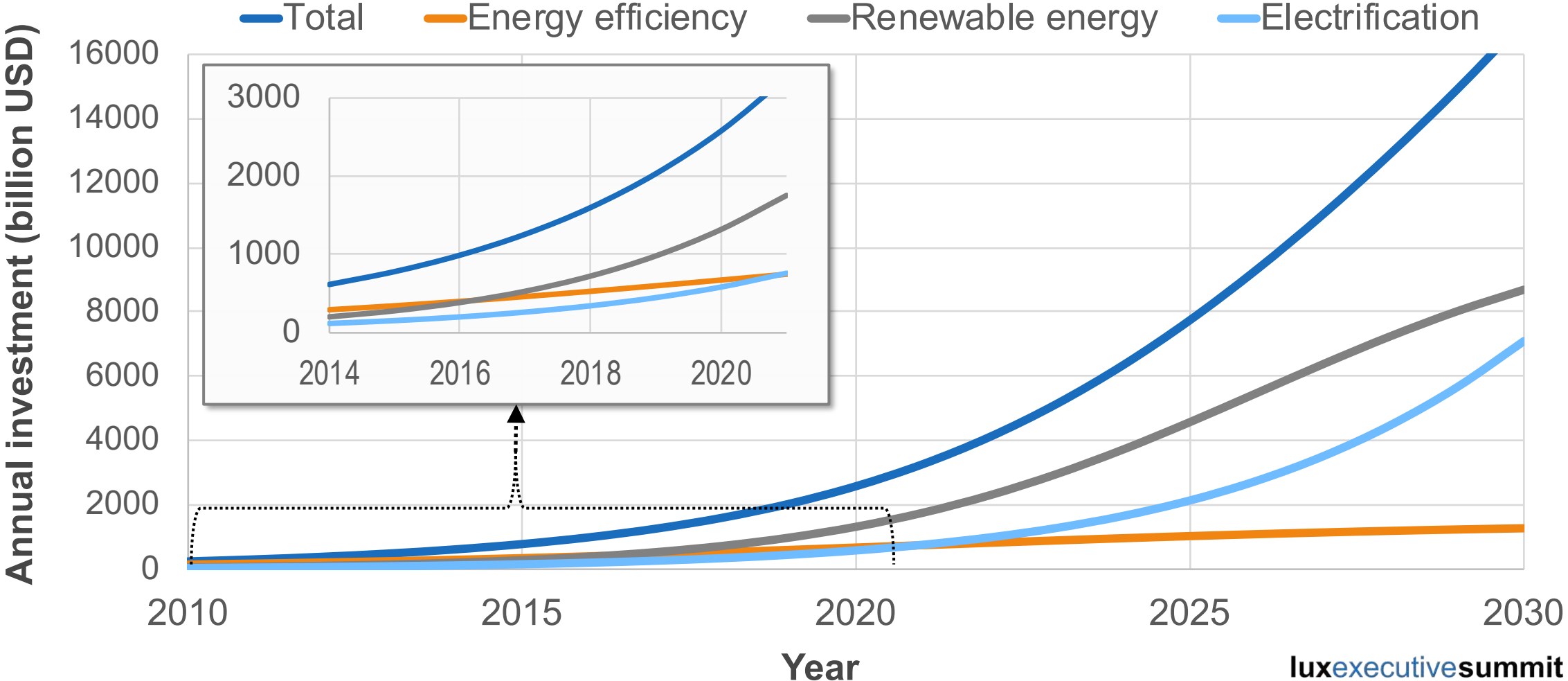
Varies by country; between 0.5% and 13% of GDP

Based on the most aggressive promised reduction

Still a conservative estimate;
the most aggressive plans are not enough yet

With a steep ramp-up in time required

Market growth over time



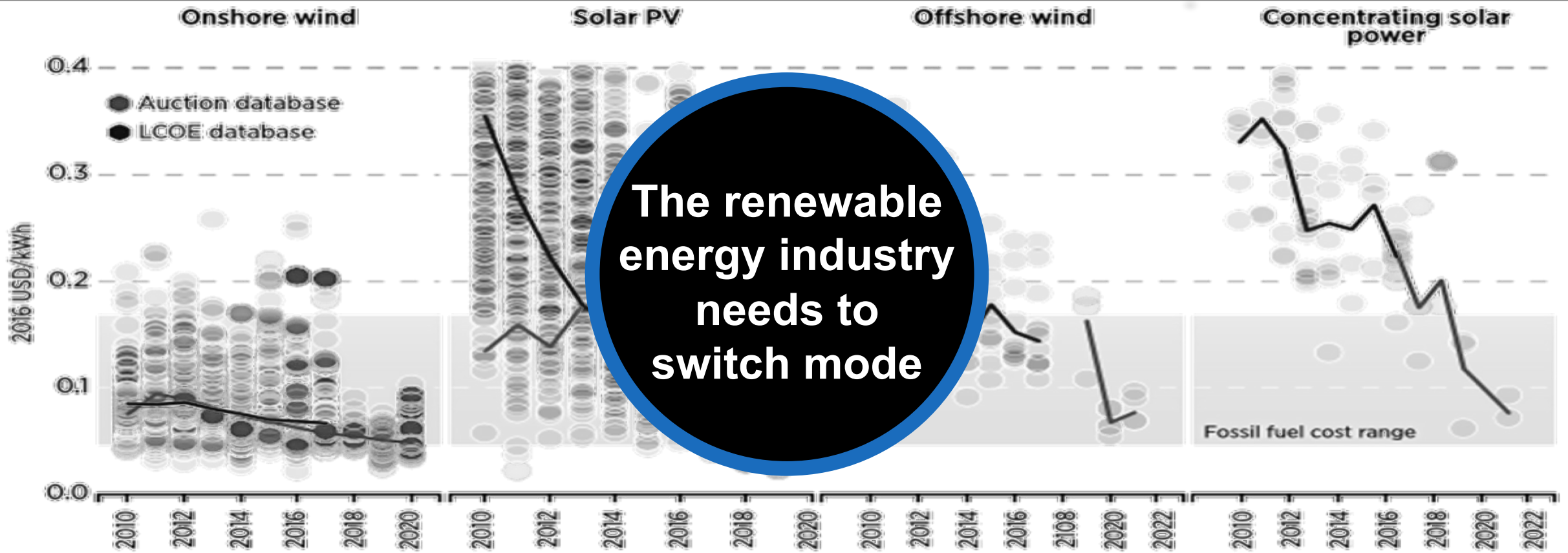
The background of the slide is a photograph of a large-scale renewable energy installation. In the foreground and middle ground, there are rows of solar panels mounted on metal frames, tilted towards the sun. In the background, several wind turbines are visible against a clear sky. The entire image has a semi-transparent blue overlay.

The value capture issue

There is a market, but do you also make money?



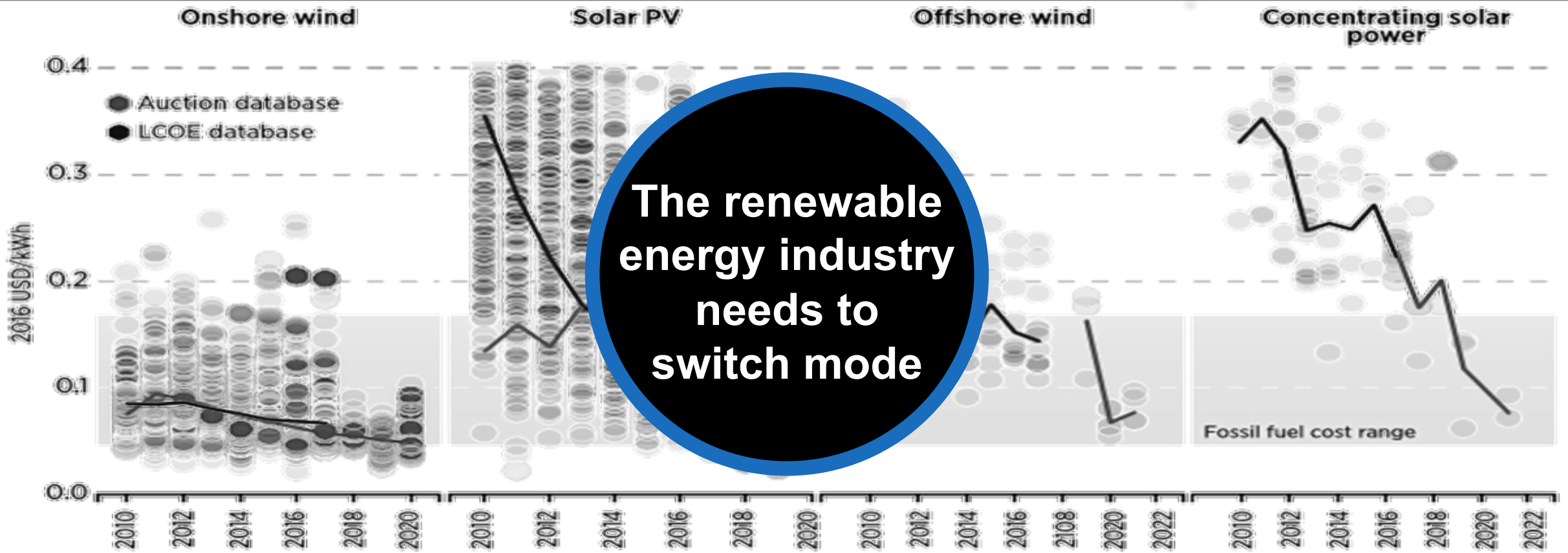
**The renewable
energy industry
needs to
switch mode**



The race to grid parity began in the 1970s

Many renewable options are now below grid parity

So there is value, margin



The race to grid parity began in the 1970s

Many renewable options are now below grid parity

So there is value, margin

The industry needs to capture that margin

But, auctions suggest the race to the bottom continues

What business model will capture this value?

Governments are now cashing value from innovation

2014: EU investments in renewable energy totaled about €60B with 50% subsidies



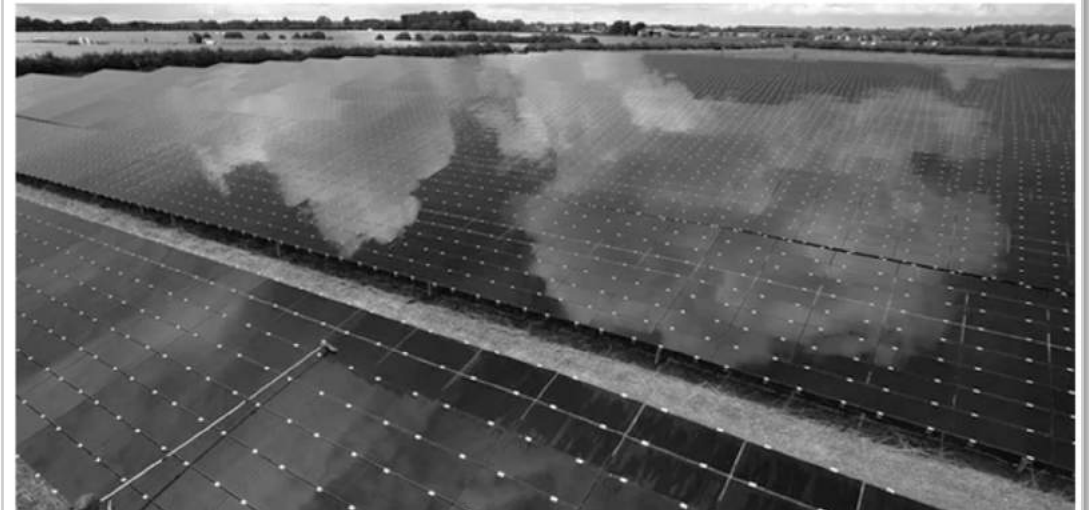
The Netherlands is building the world's first subsidy-free offshore wind farms

Part of the nation's big push to quickly build out clean-energy systems, they will be built in the North Sea by 2022.

2017 / 2018: First wind and solar projects granted with no subsidy

This summer was greenest ever for energy, says National Grid

Carbon emissions pushed to lowest level yet as first subsidy-free large solar power project opens in the UK



Governments are now cashing value from innovation

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**Huge value generation through innovation.
Value capture by governments only.**



Strategies to capture value

Mass Production	Always produce power at the lowest price	Build an asset base with good technology and spatial distribution
Wholesale		
Retail		
Service		

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Wholesale	Be the electricity oil terminal company	Arbitrage as the primary business logic. Buy low, store, sell high
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Service		

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Retail	Be the key player in running the market	Assemble and manage as many users as possible
Service	Help energy users become prosumers	Build software to manage assets and contracts

A map for capturing value for each strategy

	Sensor	Equipment	Software
Mass Production	<div> <div>LIQUID ROBOTICS A Boeing Company</div> <div>  <div>AlsoEnergy beyond measure</div> </div> <div>  <div>SENSURON ENGINEERING AT THE SPEED OF LIGHT</div> </div> <div>  <div>SOLARBRUSH CLEANER SOLAR ENERGY</div> </div> </div>	<div> <div>  <div>tessolar</div> </div> <div>  <div>Viking Heat Engines</div> </div> <div>  <div>TRIOPEN</div> </div> </div>	<div> <div>Tigo®</div> <div>ThingWorx</div> <div>  <div>RAYcatch</div> </div> <div>  </div> </div>
Wholesale		<div> <div>  <div>UET</div> </div> <div>  <div>PRIMUS POWER</div> </div> <div>  <div>ESS INC</div> </div> <div>  <div>POWERBLOX</div> </div> </div>	<div> <div>  <div>AutoGrid</div> </div> <div>  <div>WDT</div> </div> <div>  <div>GreenCharge</div> </div> <div>  <div>OPower</div> </div> </div>
Retail	<div>  <div>Bright Sensors SA</div> </div>	<div> <div>  <div>bpl</div> </div> <div>  <div>Tecogen</div> </div> <div>  <div>PHYSEE</div> </div> <div>  <div>primuswindpower</div> </div> </div>	<div> <div>  <div>REGALGRID sharing your power</div> </div> <div>  <div>ELECTRON</div> </div> <div>  <div>POWER LEDGER</div> </div> <div>  <div>Grid regularity</div> </div> <div>  <div>TEN-DRIAL</div> </div> </div>
Service		<div> <div>  <div>PHYSEE</div> </div> <div>  <div>primuswindpower</div> </div> </div>	<div> <div>  <div>tado°</div> </div> <div>  <div>BuildingIQ</div> </div> <div>  <div>ONZO</div> </div> <div>  <div>SUNVERGE</div> </div> </div>



How others are leveraging technology

Examples

Total turning itself into a power company

Acquisitions and investments to build a new business

Storage
(> \$1.5 billion)



Management and integration
(~ \$ 1 billion)

Generation
(> \$1 billion)



Company:



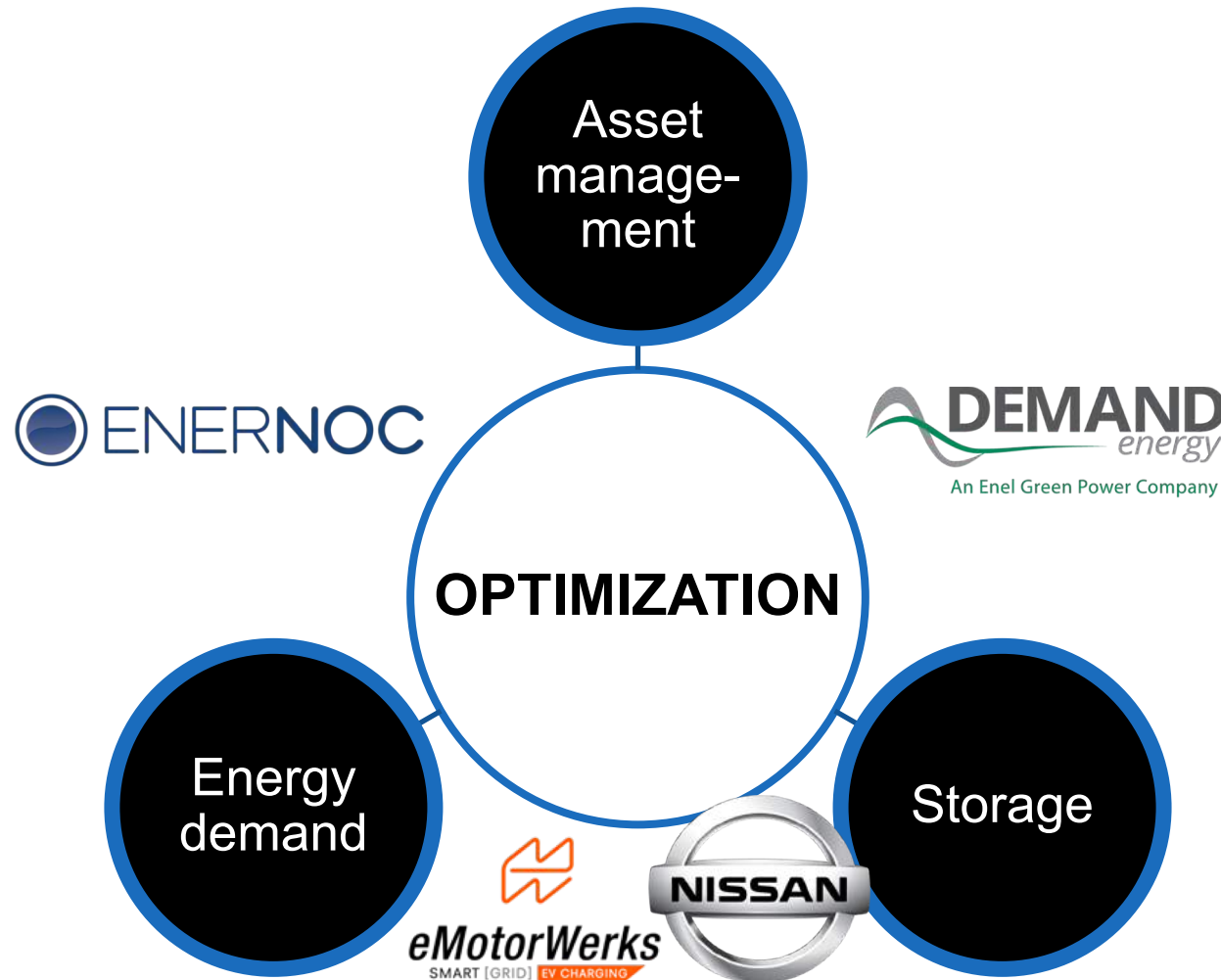
HQ: France
Revenues: \$166 billion
Profits: \$6.9 billion

Preparing for:

**Mass
Production**

Wholesale

Enel: turning a classic utility into a service company



Company: 

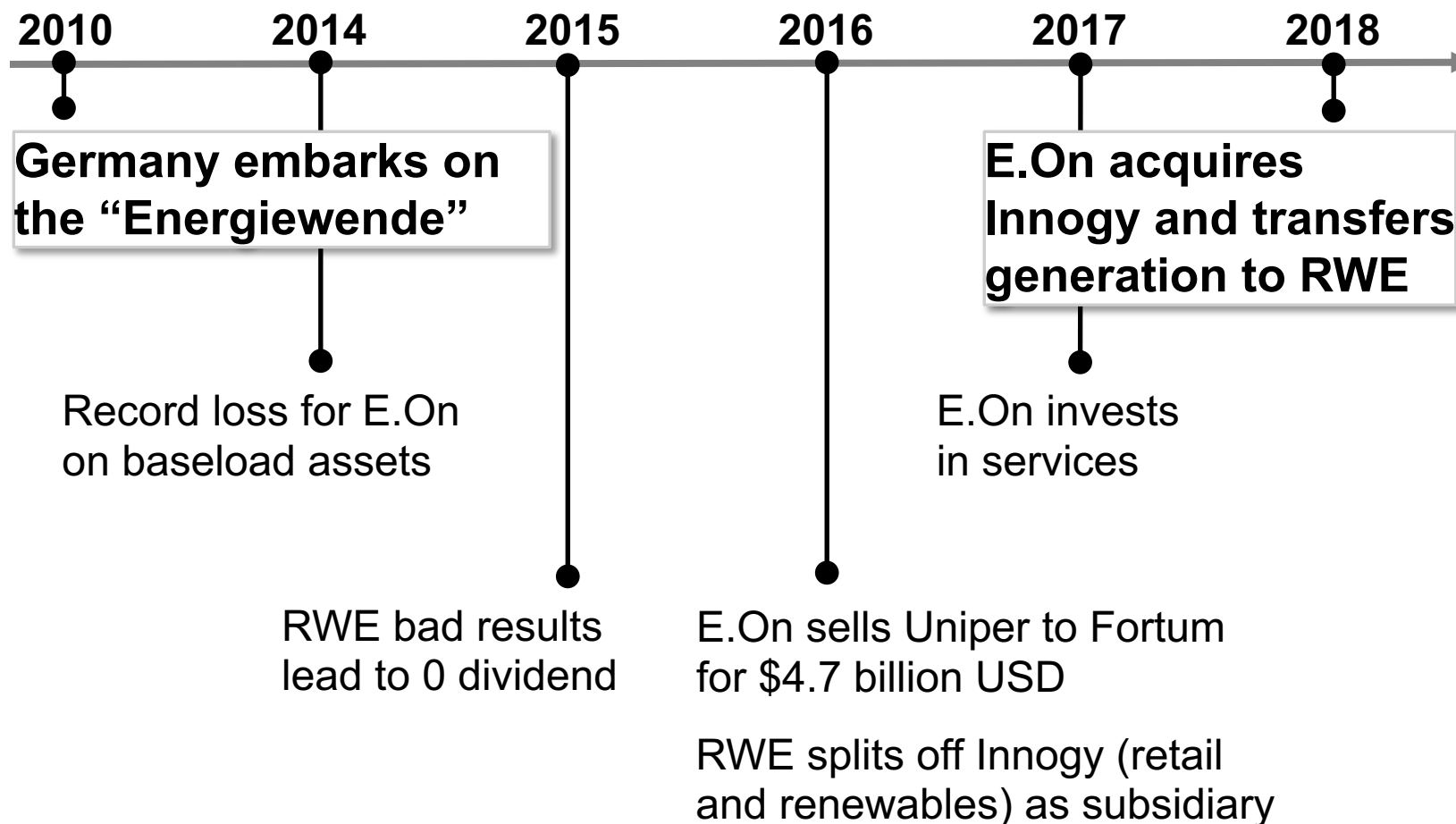
HQ: Italy
Revenues: \$87 billion
Profits: \$4.5 billion

Preparing for:

Retail

Service

Germany's utilities' reshuffle



Company: **e-on**
uni
per

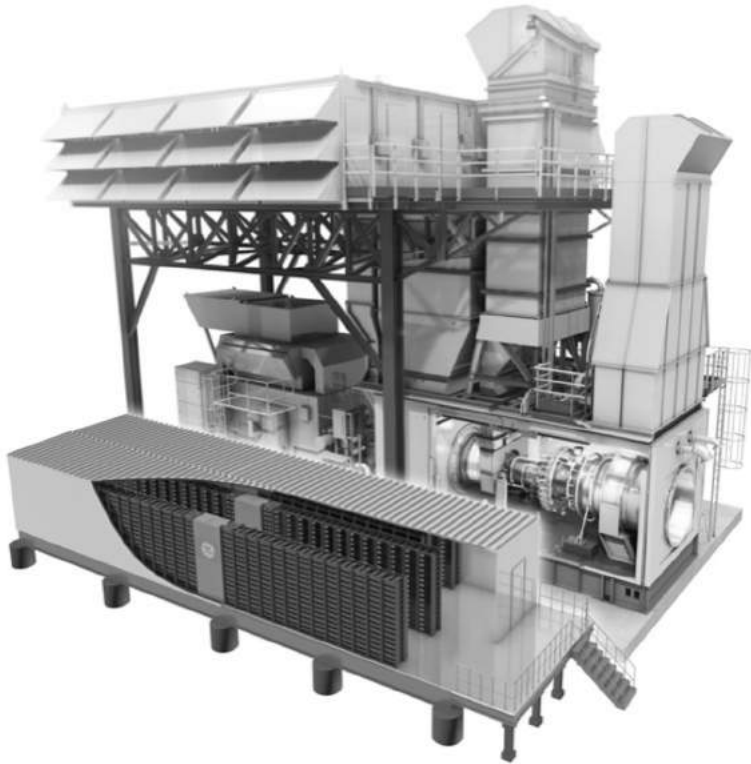
HQ: Germany
Revenues: \$46.6 billion
Profits: (\$20) billion

Preparing for:

Retail

Service

GE: developing wholesaler hardware



Combination of:
50 MW CC gas turbine
10 MW, 4.3 MWh battery

Provides a sweet spot
between gas peakers (cheap)
and storage (long-term need)

Company:



HQ: USA
Revenues: \$122 billion
Profits: \$5.8 billion

Preparing for:

**Mass
Production**

Wholesale



It's about integration...with a purpose



It's about integration...with a purpose

There is a large market opportunity, but making a margin is not trivial.



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Value capture is all about smart integration.

It's about integration...with a purpose

There is a large market opportunity, but making a margin is not trivial.

Value capture is all about smart integration.

Pick your preferred role; buy and build hardware and software to carve out a unique position.



2018

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Thank you for joining us.




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