

Power-Water Nexus

Building sustainable and resilient energy systems

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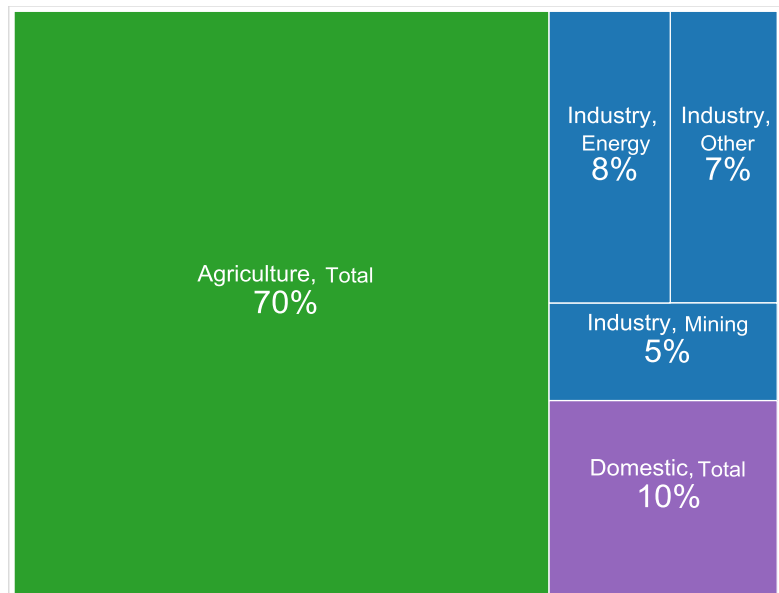
Water by the numbers

Demand on resources

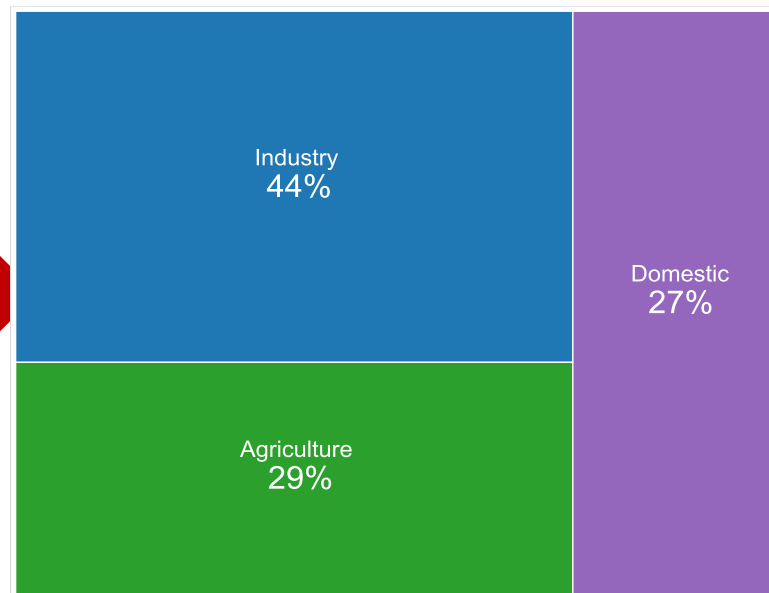
Agriculture dominates global withdrawals ...

... But, industry dominates in advanced economies

Global Water Withdrawals
Percentage (%)



Advanced Economies Water Withdrawals*
Percentage (%)



* IMF definition for advanced economies

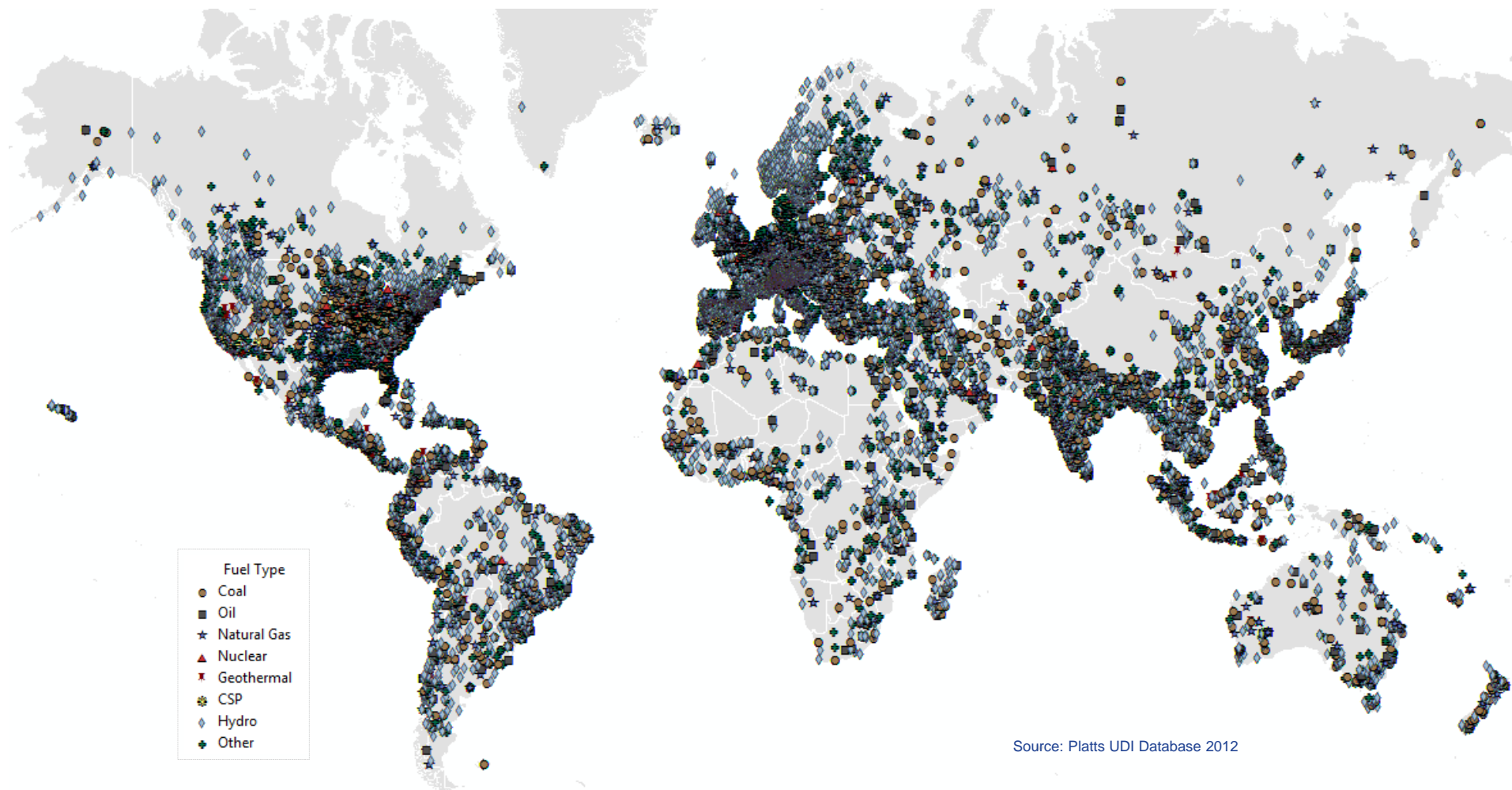
Source: Pacific Institute, The World's Water Vol 7
<http://www.worldwater.org/data.html>

Developing economies are moving
in the same direction

Surveying the Challenge

Global thermal & hydroelectric generation units

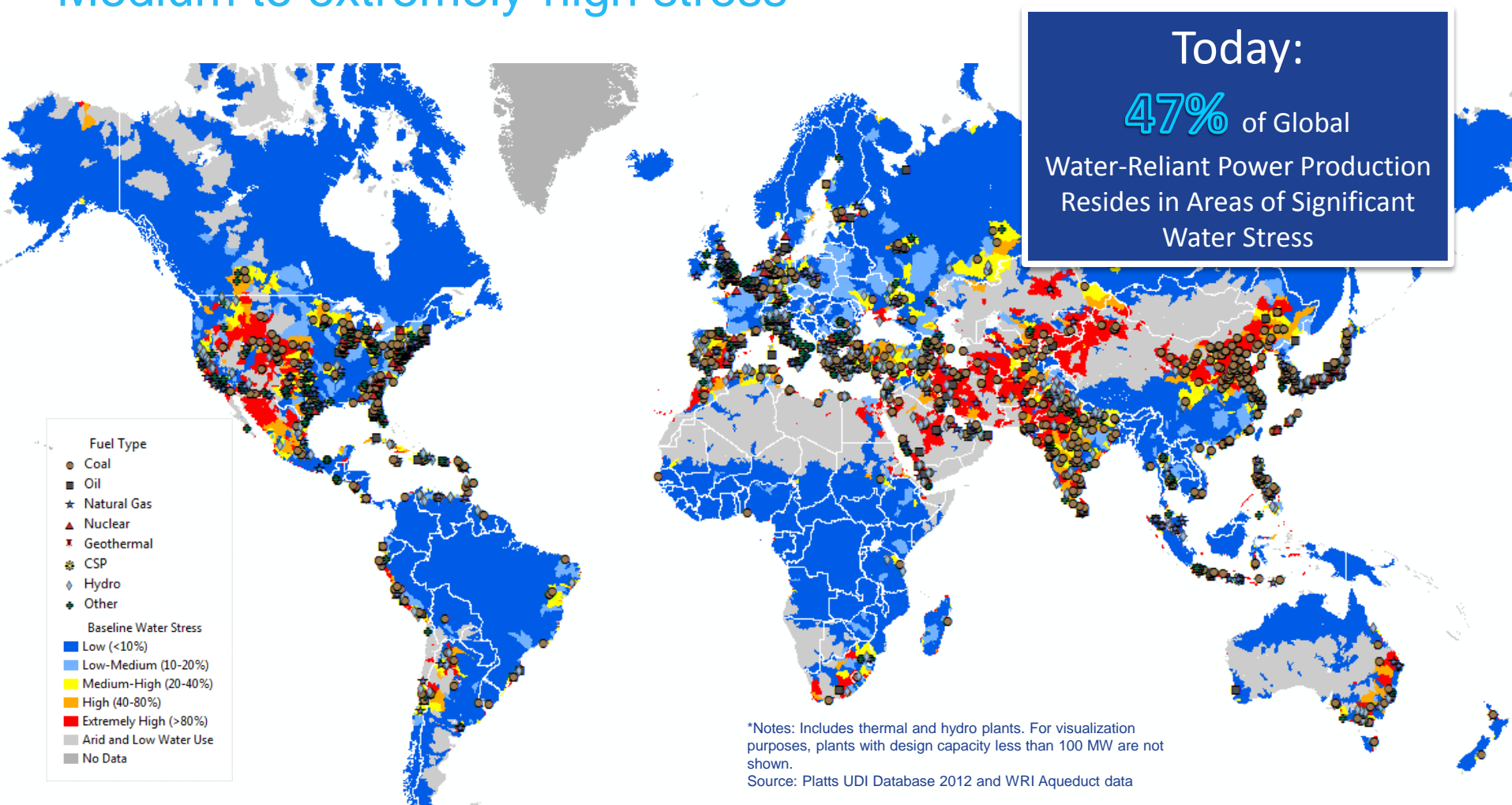
Water is a key input to running the global power system



Over 3,800 GW and 55,000 units

Global generation units with water stress*

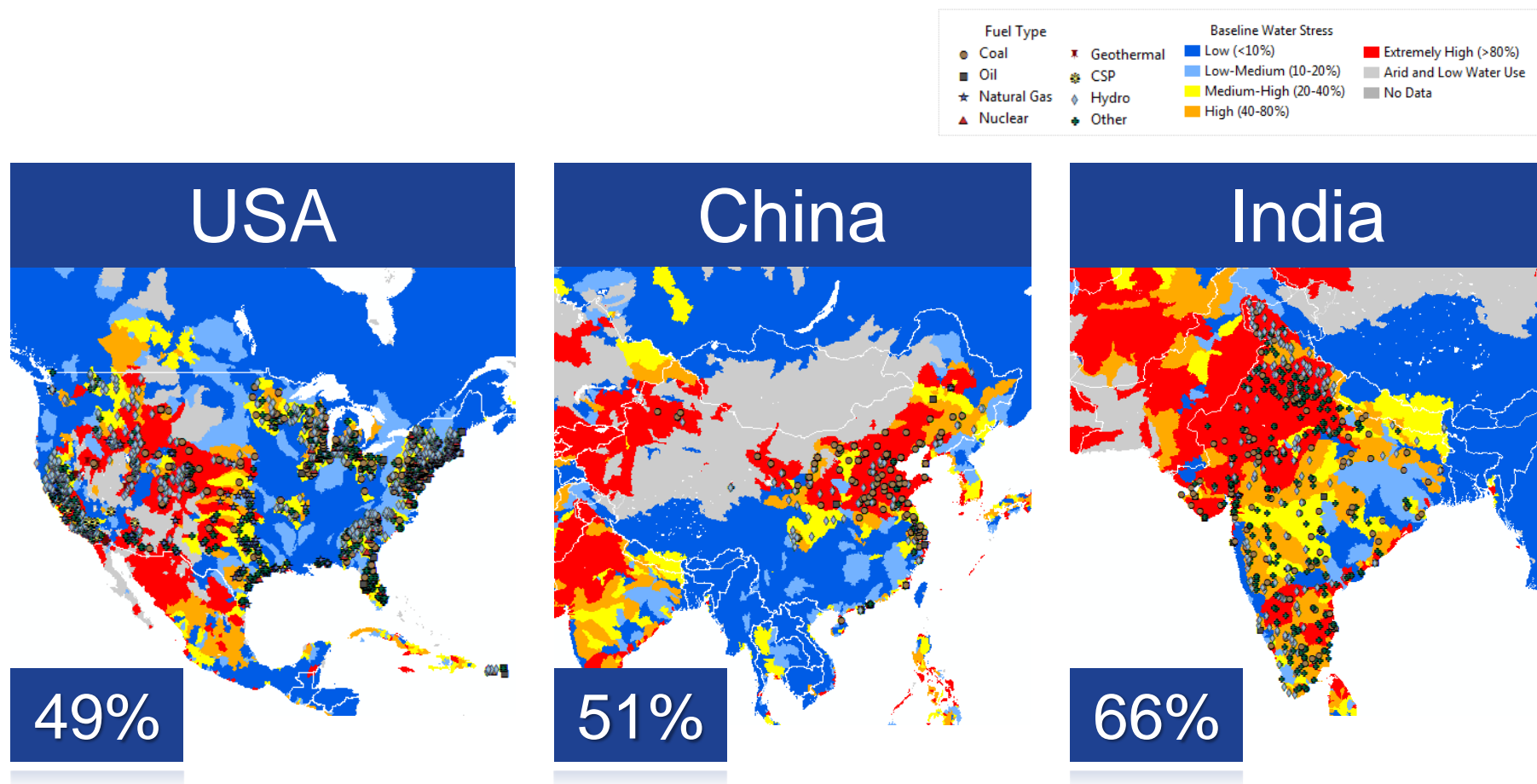
Medium to extremely-high stress



Over 26,000 units are in areas of medium to extremely-high water stress

Water-reliant generation units

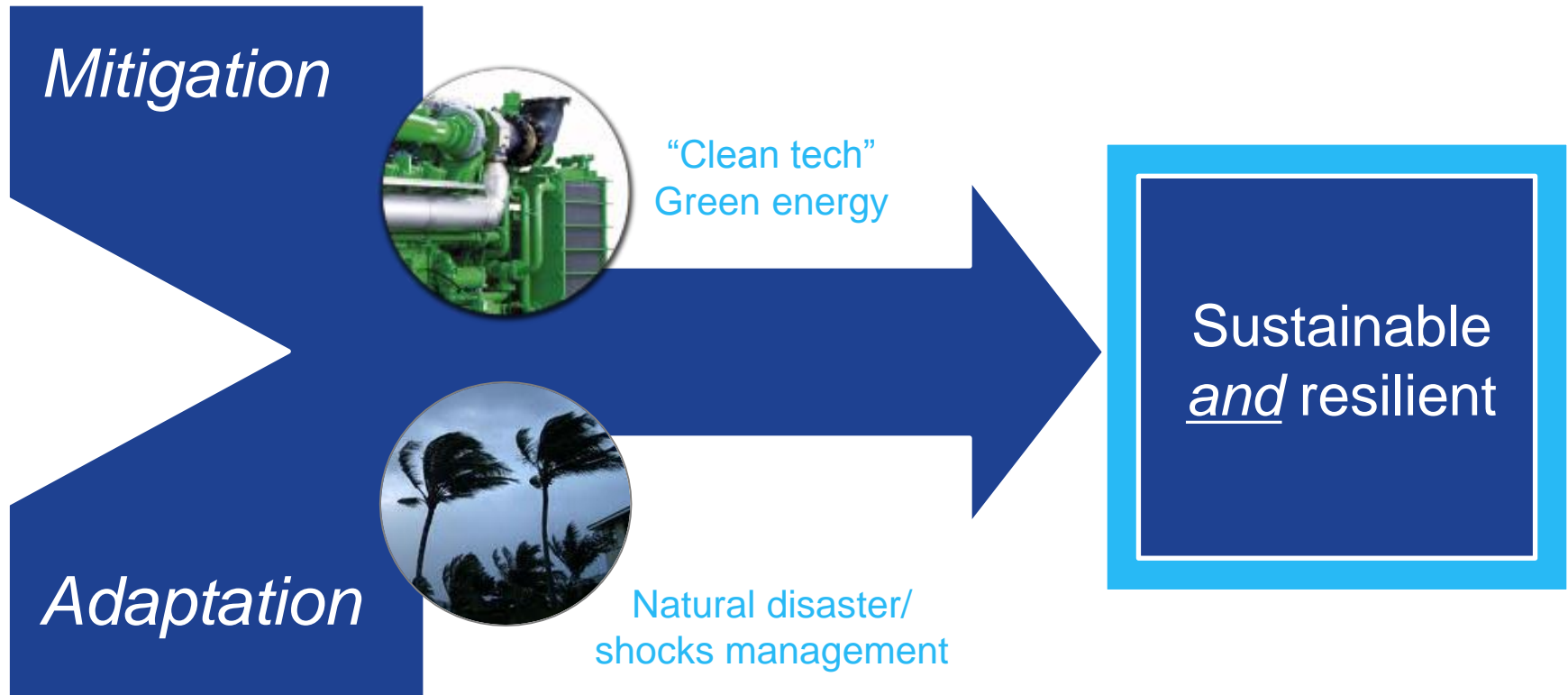
Percentage residing in areas of medium to extremely-high water stress



Managing the Risk

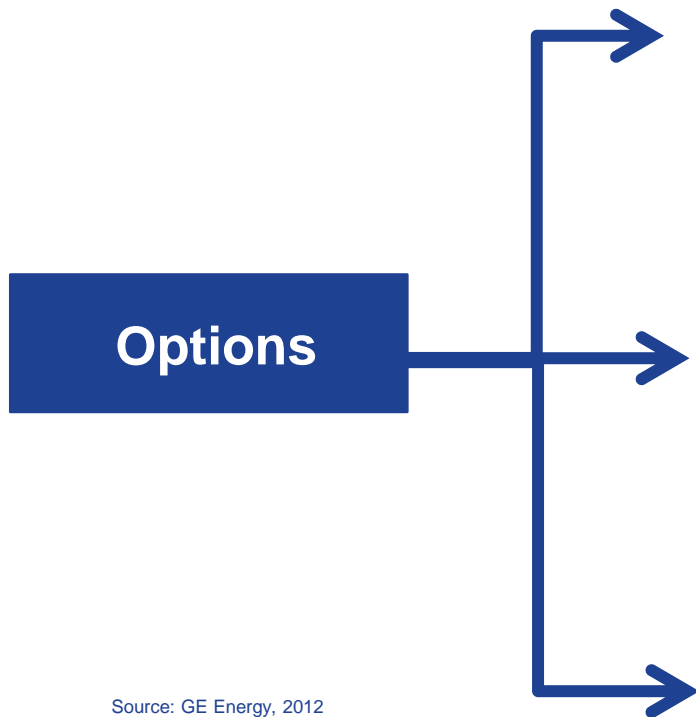
Shifting global narrative/imperative

Growing attention to both mitigation and adaptation



Responses to water stress

Constraints drive three potential paths



Source: GE Energy, 2012



Shift to alternate water source... saline or brackish water

Public Perception 90%

of Americans believe it's important that utilities and power companies protect water resources.

87%

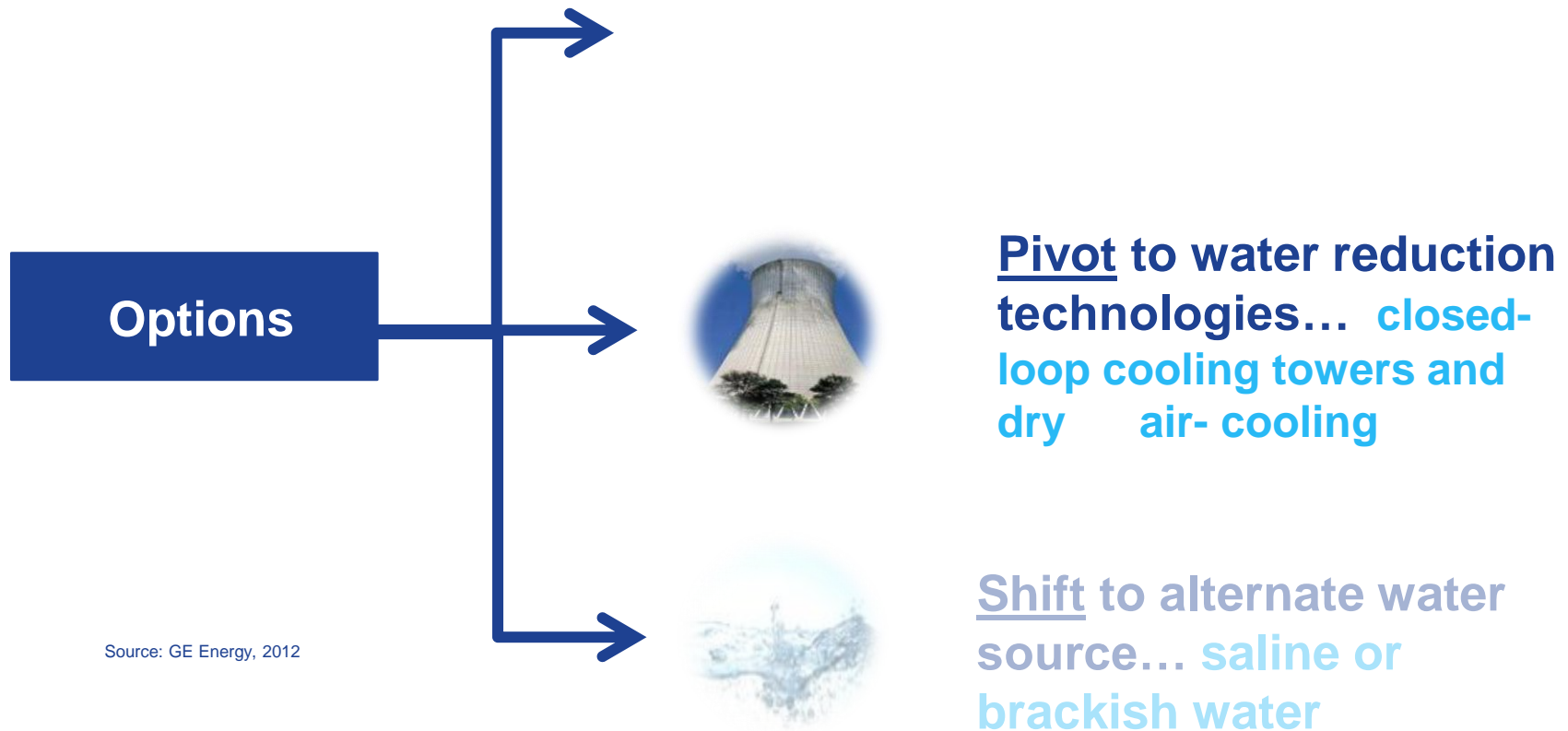
of Americans are in favor of using recycled water for power generation, more than any other application.



imagination at work
Source: StrategyOne 2012

Responses to water stress

Constraints drive three potential paths

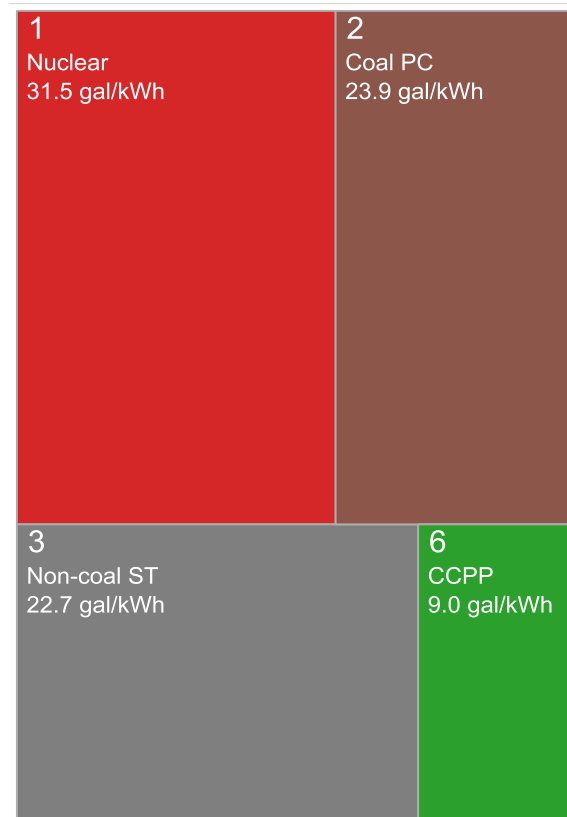


Source: GE Energy, 2012

Water intensity of power generation

Water withdrawals by cooling technology

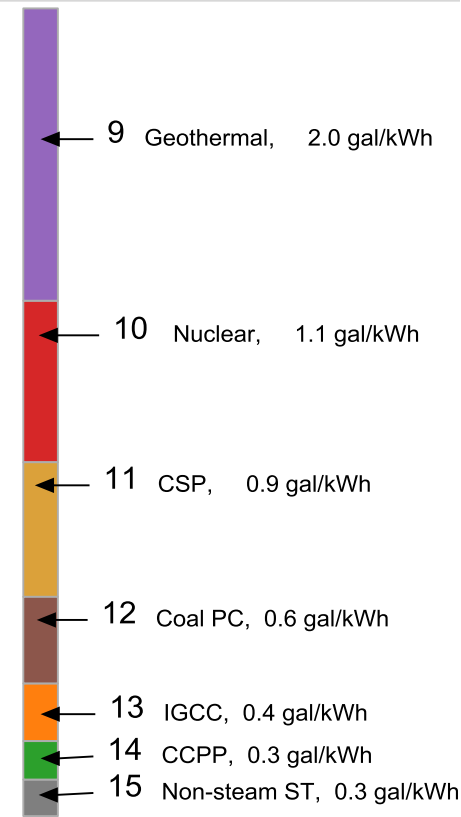
Once-through



Cooling pond



Cooling tower

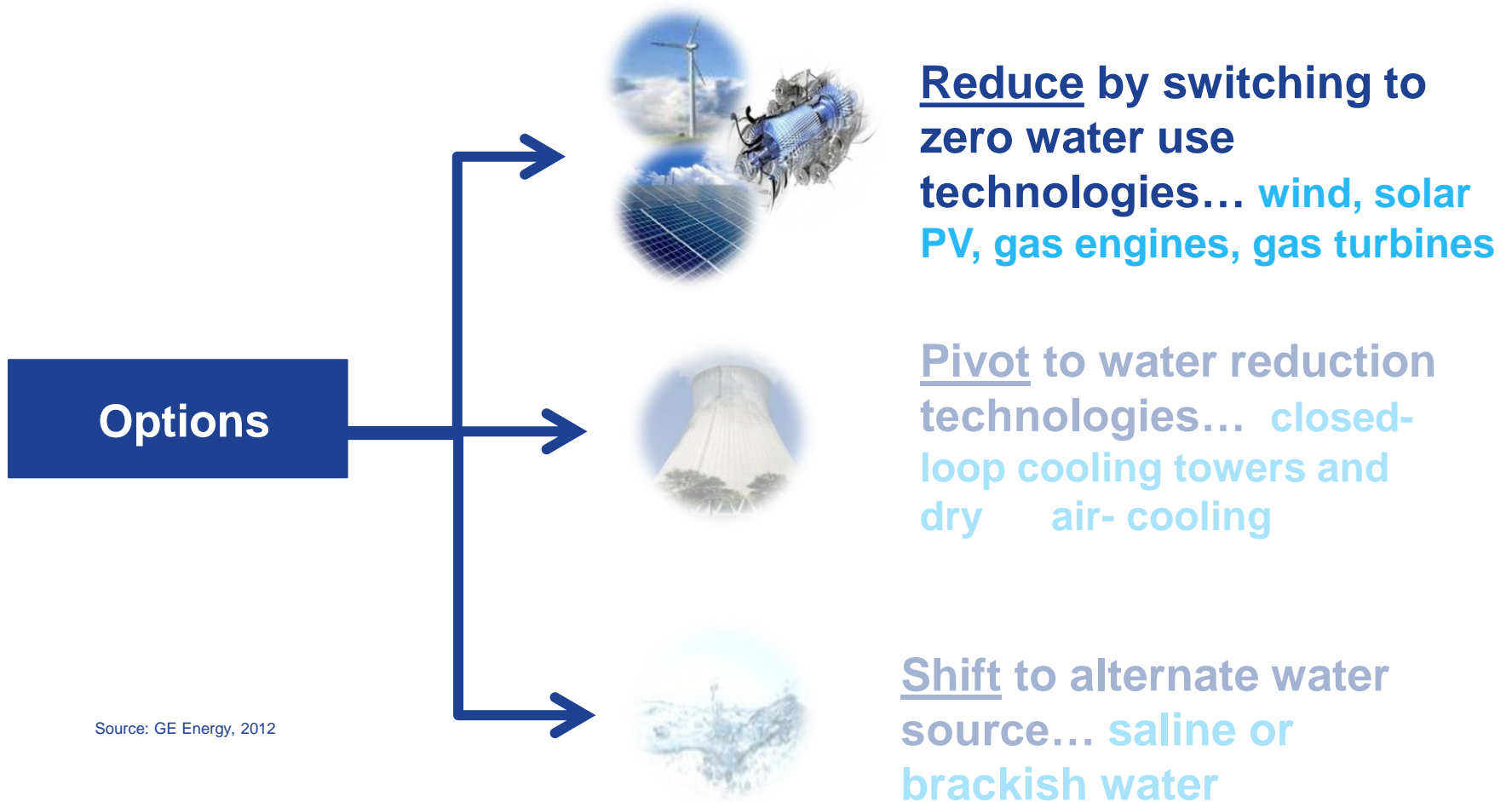


Source: NETL 2010

Shifting can reduce water withdrawals

Responses to water stress

Constraints drive three potential paths

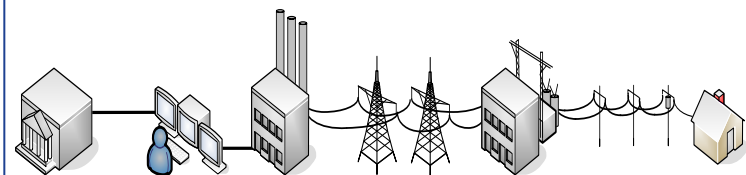


Source: GE Energy, 2012

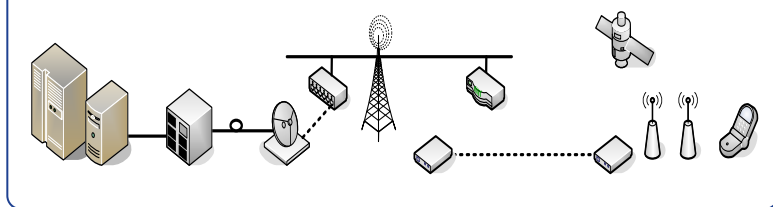
Technology integration

Building infrastructure synergies to reduce water demand

Electrical infrastructure



Information infrastructure



Intermittent renewables



Flexible gas turbine technology



Joining capabilities for sustainability and resilience

Benchmarking water demand

Water requirements in terms of megacities



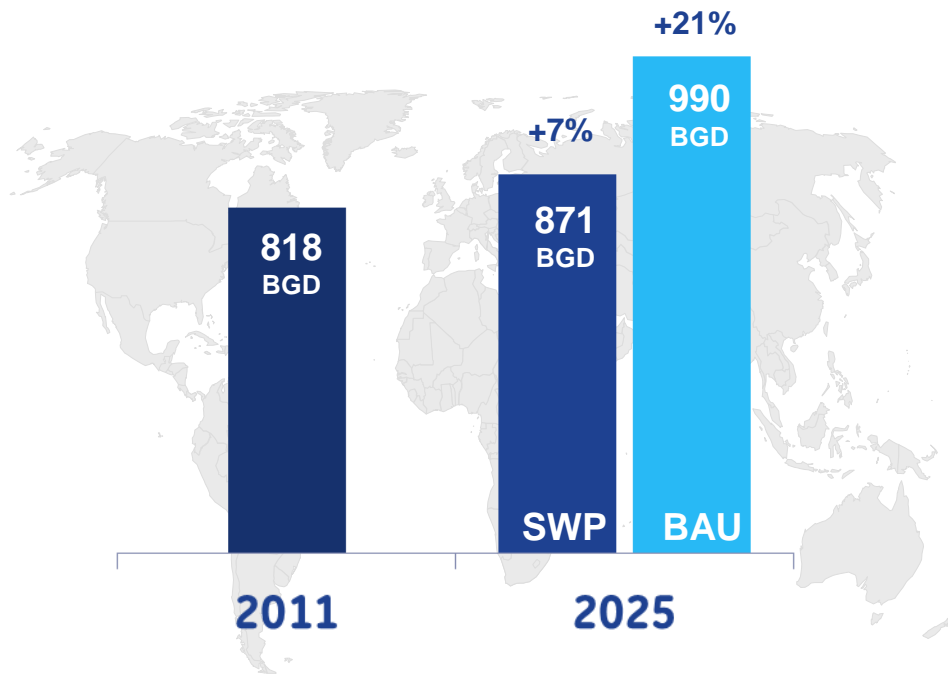
= 1.5 billion gallons per day

New York City peak water demand

Global thermoelectric power-water footprint

How could it evolve?

Global Thermoelectric Power Water Withdrawals (BGD)



Billion gallons per day (BGD)

Today

2025

545
megacities

+115
660 megacities



+36
581 megacities

Notes: Based on NY City requiring a water supply of 1.5 BGD in 2005
Source: GE Global Strategic Intelligence; NY Dept. of Env. Conservation

Effective management can reduce growth ...
equivalent to the withdrawals of 79 megacities

Summary

- ✓ Water constraints are already significant in certain locations & are expected to intensify
- ✓ Minimizing water usage in power will become increasingly important
- ✓ Managing stress and shocks requires sustainable and resilient power systems
- ✓ To achieve a sustainable and resilient power system, a significant shift to zero water use technologies & less water intensive cooling technologies will be required

Adjusting to meet changing
global conditions

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