

Redrawing the climate change map: What should we be preparing for? Climate change and extreme weather impacts on the energy sector

Ferenc L. Toth

Planning & Economic Studies Section (PESS)

Department of Nuclear Energy

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Sector Resilience

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1. Introduction

IPCC AR5 WGI:

- gradual changes in climate attributes
- changes in weather extremes

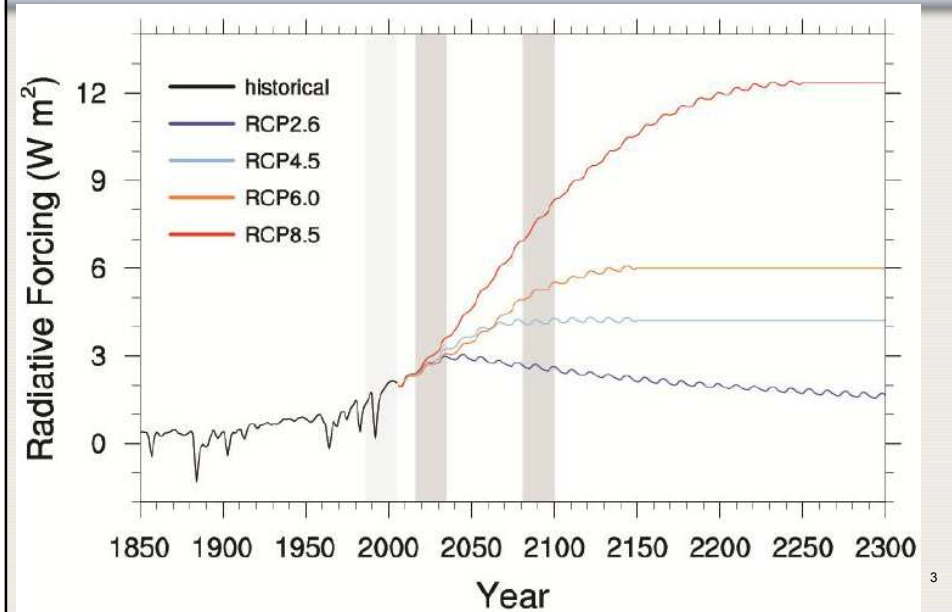
IPCC AR5 WGII – Chapter 10:

- impacts on energy systems
 - energy (re)sources
 - conversion from primary into secondary forms

Main messages

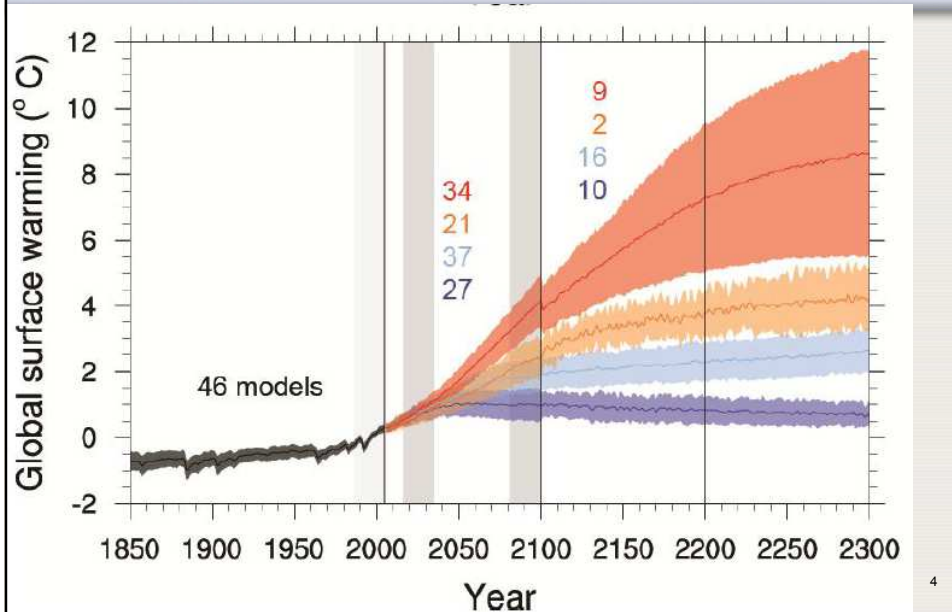


2. Climate change projections – AR5



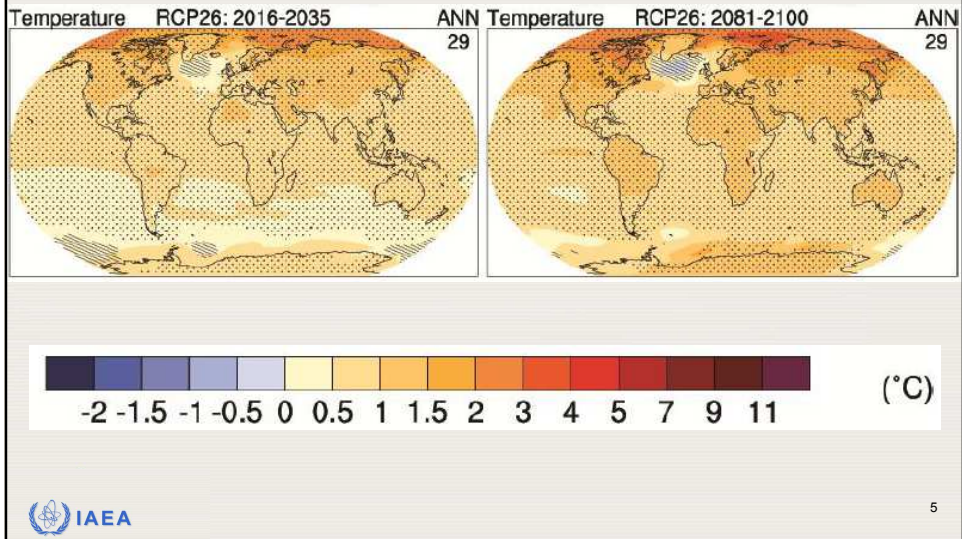
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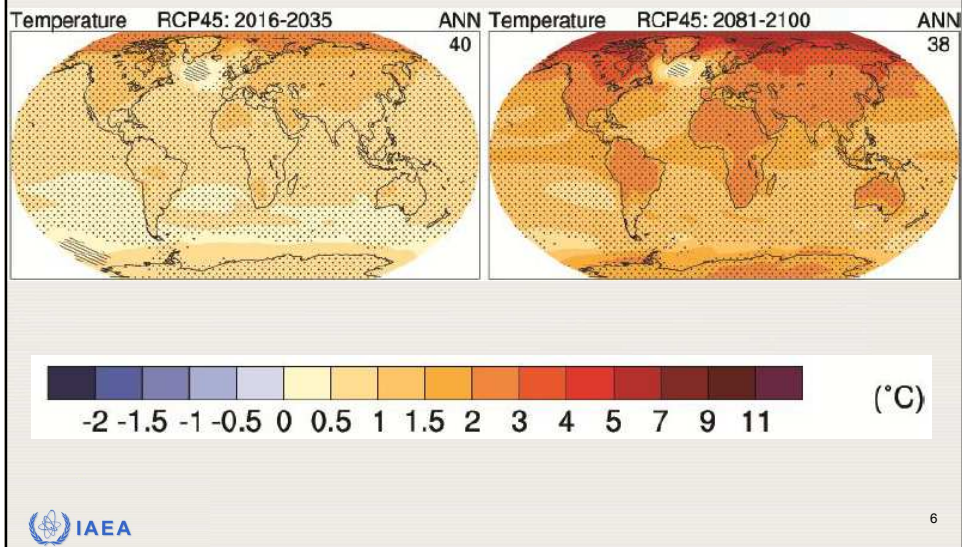


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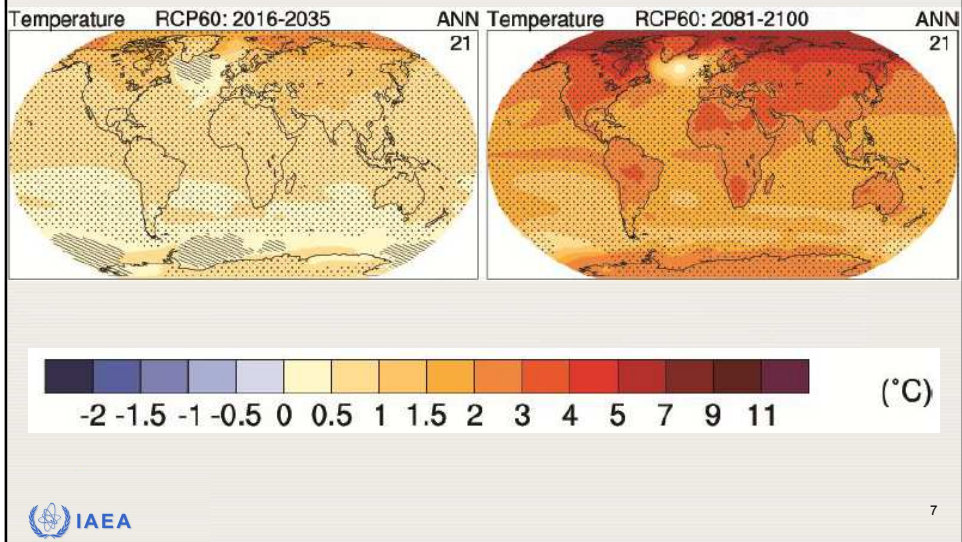
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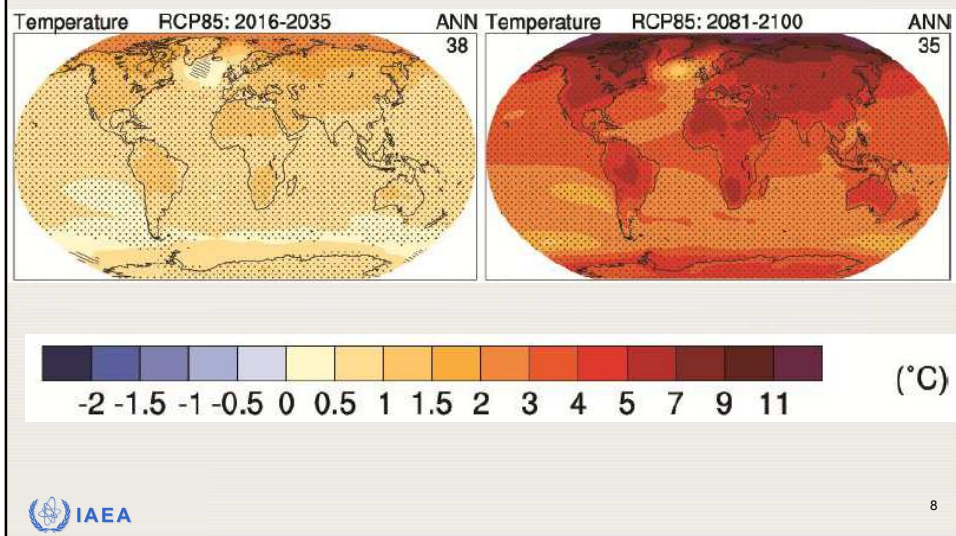
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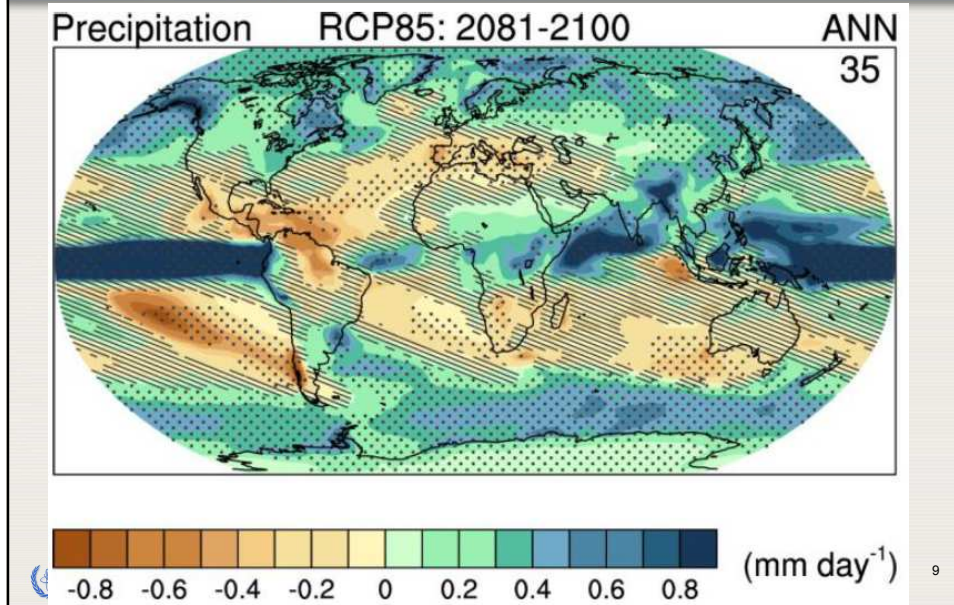
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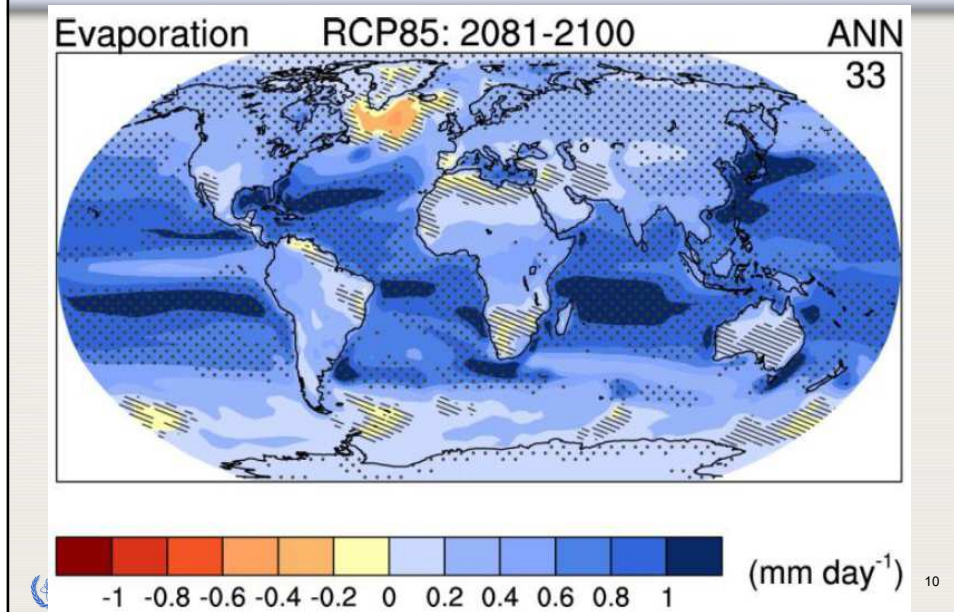
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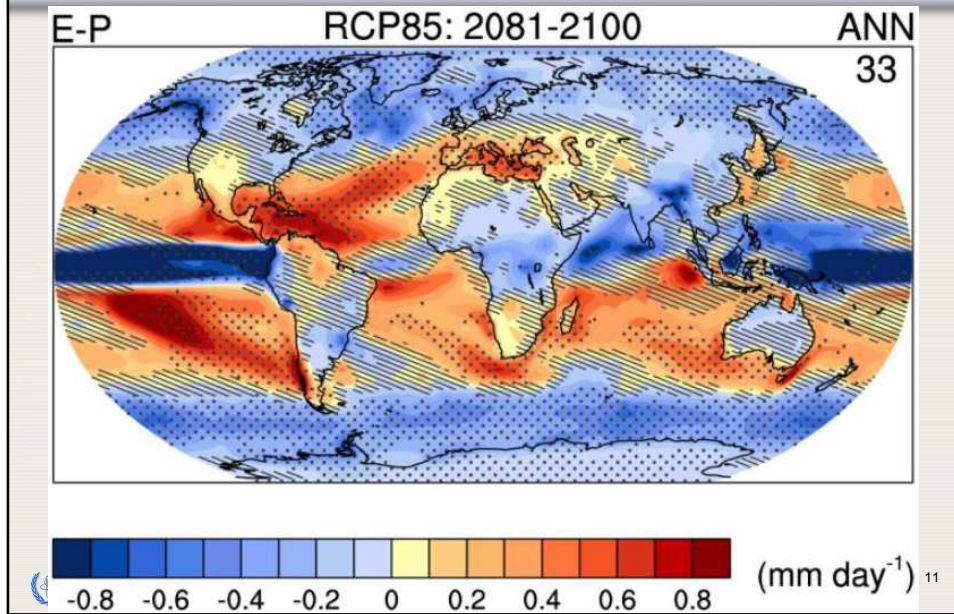
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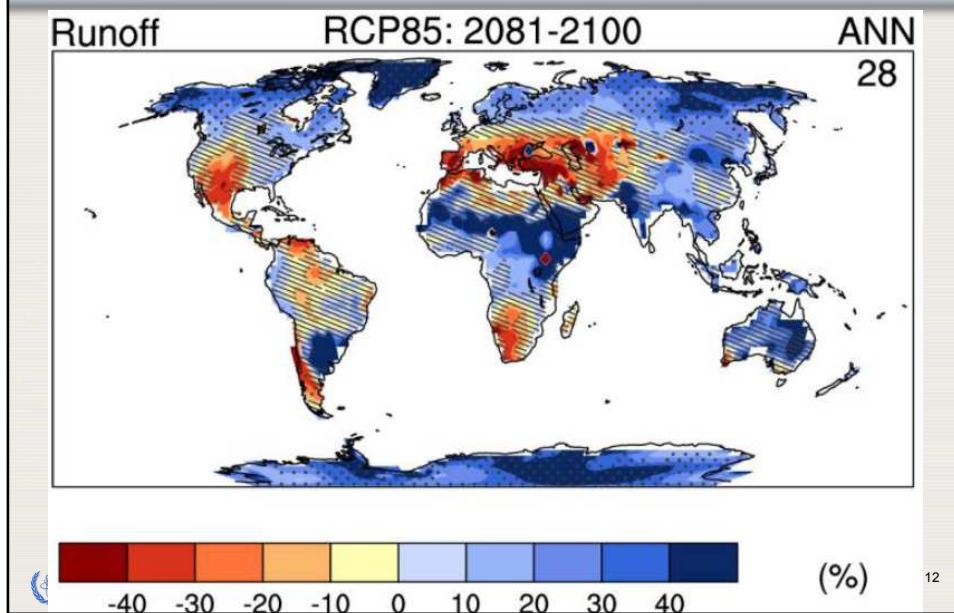
2. Climate change projections – AR5



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Phenomenon and direction of trend	Likelihood of further changes	
	Early 21 st century	Late 21 st century
Warmer and/or fewer cold days and nights over most land areas	Likely	Virtually certain
Warmer and/or more frequent hot days and nights over most land areas	Likely	Virtually certain
Warm spells/heat waves. Frequency and/or duration increases over most land areas	Not formally assessed	Very likely
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation.	Likely over many land areas	Very likely over most mid-latitude land; wet tropical regions
Increases in intensity and/or duration of drought	Low confidence	Likely on a regional to global scale
Increases in intense tropical cyclone activity	Low confidence	More likely than not in WNP and NA
Increased incidence and/or magnitude of extreme high sea level	Likely	Very likely



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3. Energy sector impacts

Energy (re)source	Gradual climate change	Extreme weather events	Combinations
Coal		P [^] flooding open pit sites	T [^] + P ^v + W [^] dust blown from stockpiles
Oil and gas	T [↑] melting permafrost: destabilizing equipment SL [↑] inundating coastal / off-shore sites	W [^] damaging onshore wells, cyclones damaging offshore platforms	SL [↑] + W [^] severe damage to onshore wells SL [↑] + S or cyclones severe damage to offshore platforms
Uranium		P [^] flooding open pit sites	
Hydro	T [↑] higher evaporation losses P ^{↑/↓} more/less water availability		
Wind	W ^{↑/↓} more/less wind resource		
Solar	I ^{↑/↓} more/less solar energy		



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3. Energy sector impacts

Conversion technology	Gradual climate change	Extreme weather events	Combinations
Thermal power plant	T↑ decreasing thermal efficiency T↑ decreasing cooling efficiency P↓ less and warmer cooling water	T^ larger efficiency loss T^ larger cooling challenge P^ even less and warmer cooling water W^ damage cooling towers	T^ + P^ acute cooling problem T^ + P^ + W^ dust blow from stockpiles and waste (fly ash, bottom ash)
Oil refinery Gas treatment	SL↑ inundating coastal/ offshore sites	P^ flooding conversion sites	SL↑ + W^ flooding conversion sites
Nuclear power plant	Same as thermal and oil/gas.	Same as thermal and: P^ flooding emergency equipment and spent fuel storage	T^ + P^ + W^ smoke from forest fire damaging instrumentation, inhibiting access
Hydropower		P^ flood causing structural damage to dam wall, debris damaging dam / turbines T^ ice blocking turbine inlet	P^ + W^ waves causing dam overflow
Wind power	T↑ less frequent icing P↓ more dust deposition SL↑ inundating coastal/ offshore sites	W^ structural damage T^ & T^ materials/fluids failing L damaging blades	T^ + P^ ice on blades reducing efficiency, causing structural damage
Solar energy	T↑ higher SH performance T↑ lower PV and CSP efficiency	P^ material damage to PV W^ material damage SH, CSP H material damage PV	T^ + P^ + W^ dust or sand depositing on collectors reducing efficiency PV, CSP



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4. Main messages

Gradual climate change: most climate attributes

- Higher mean T, +/- P → +/- water balance
- Wind, insolation: regional variation

Changing climate → changes in weather extremes globally and in all regions, albeit unevenly; e.g.,

extreme temperatures to increase in:

- frequency: occurring more often
- intensity: reaching higher extreme values
- spatial extent: affecting larger areas
- duration: prevailing longer



IAEA - timing: spreading over larger time periods⁶

4. Main messages

Extremes:

- direct impacts on energy supply

But: also consider indirect effects through impacts on:

- health, agriculture, water, transport, energy demand

And: socioeconomic development + reducing exposure

- + preparing for adaptation: reduce/alleviate impacts

Sectors with large inertia – long lived assets:

prepare in advance, climate-safe



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IAEA - <http://www.iaea.org/OurWork/ST/NE/Pess>



...atoms for peace.

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