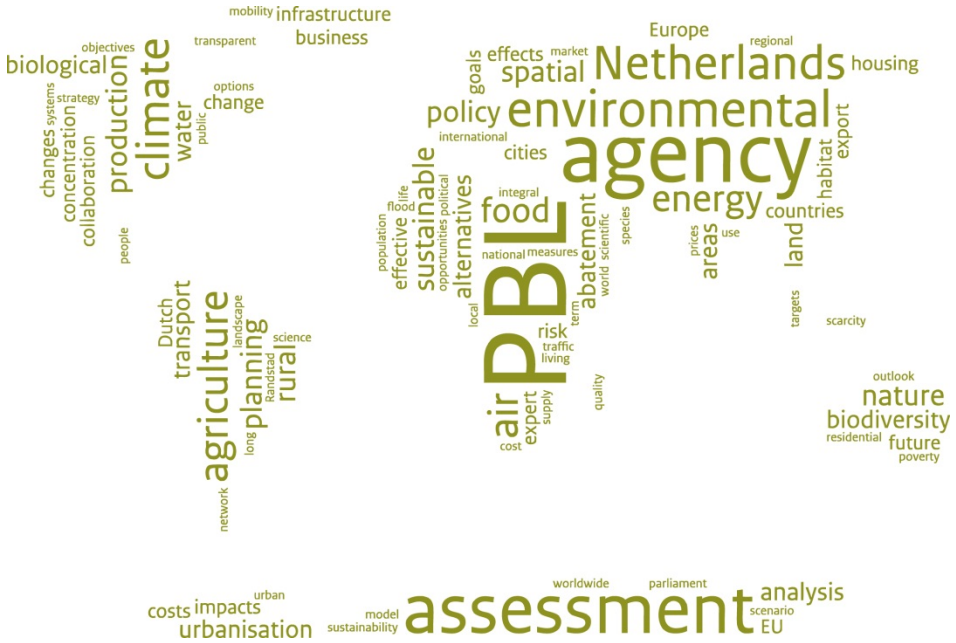

PBL Netherlands Environmental Assessment Agency

Comparing future patterns of energy system change in 2°C scenarios with historically observed rates of change

#IAMC2015

16 November 2015 – Potsdam

Contact: mariesse.vansluisveld@pbl.nl

TRANSITION PATHWAYS TO SUSTAINABLE LOW-CARBON SOCIETIES

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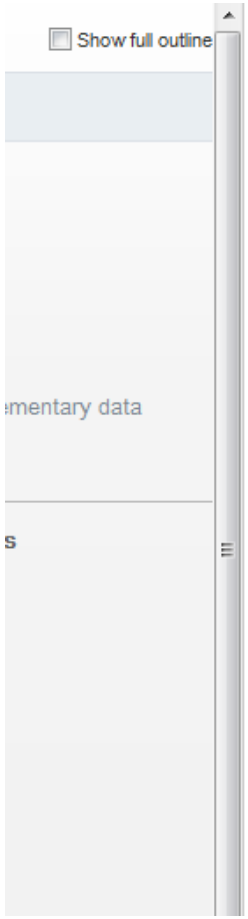

ELSEVIER

Global Environmental Change

Volume 35, November 2015, Pages 436–449

Comparing future patterns of energy system change in 2 °C scenarios with historically observed rates of change

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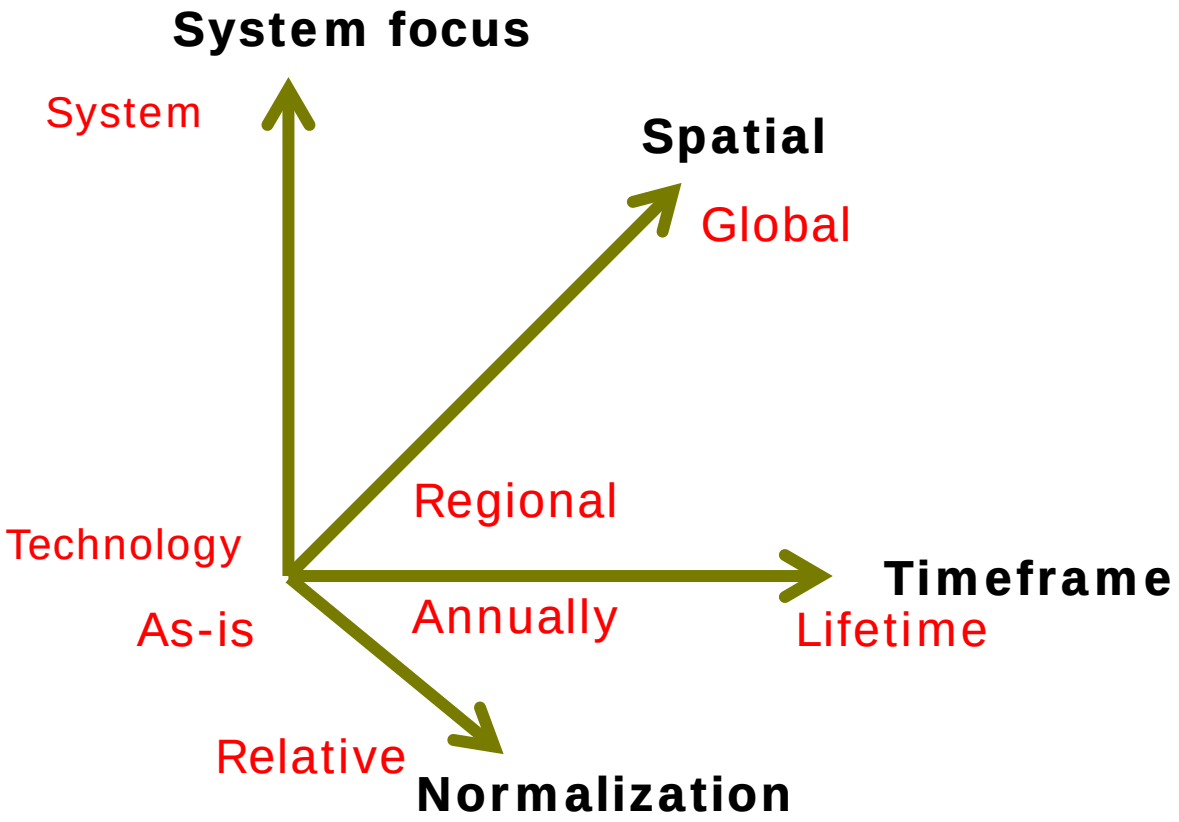
Received 9 March 2015, Revised 14 September 2015, Accepted 23 September 2015, Available online 7 November 2015

doi:10.1016/j.gloenvcha.2015.09.019

Previous studies range in focus



Our study design

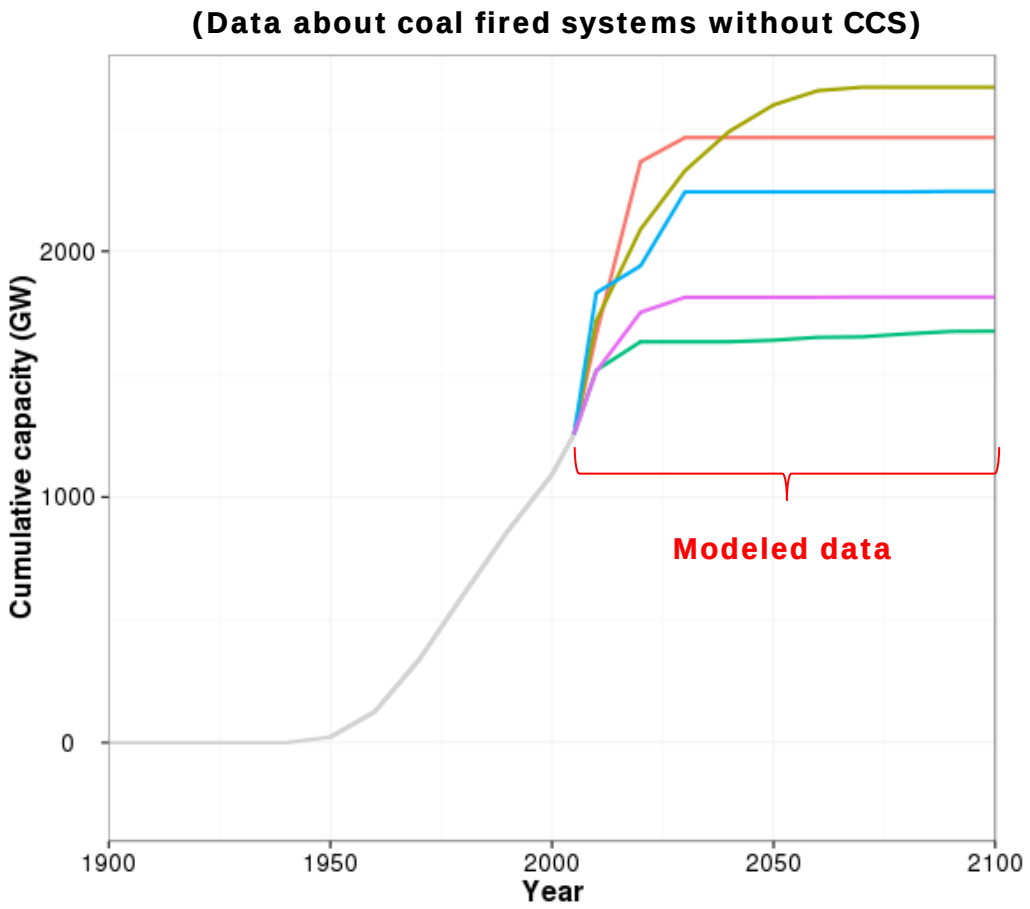
Historical data

- Links to modeled data

Modeled data:

- 5 global models
- 3 (global) scenarios:
  - ➢ Baseline: No climate target
  - ➢ Reference: Current day climate policies
  - ➢ 2 Degrees: Meeting 2°C climate target

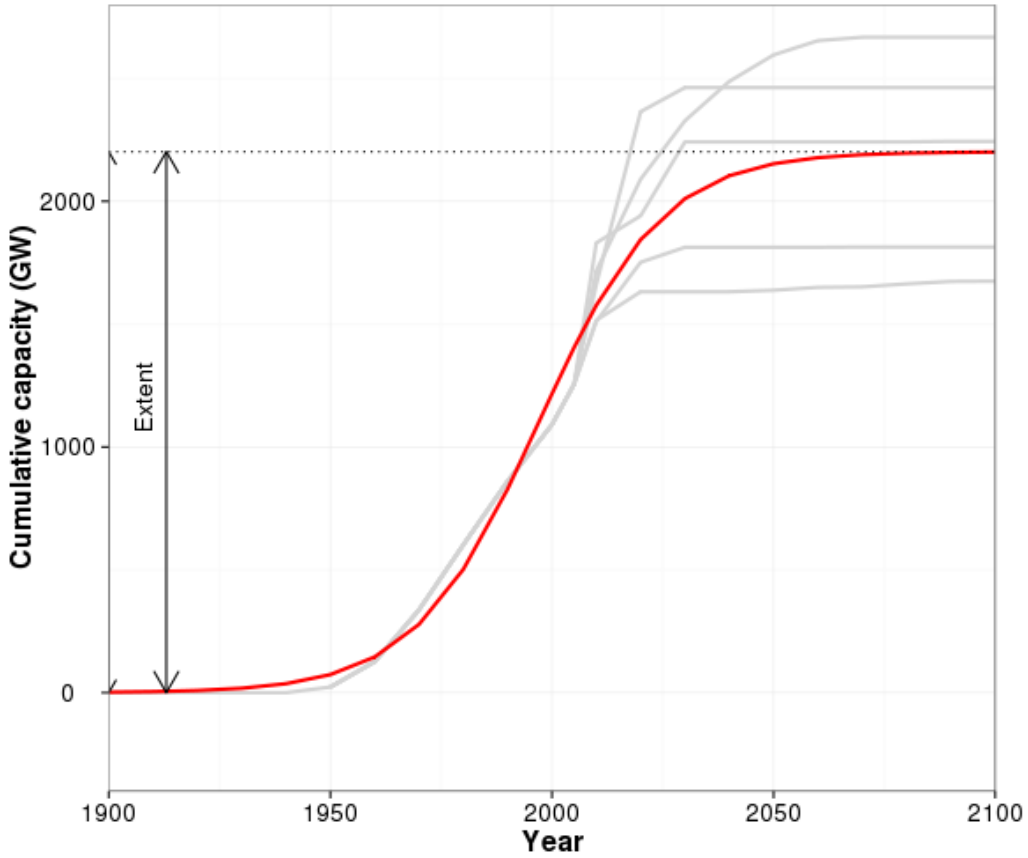
Increasing policy stringency



Key concepts for comparing rates of change

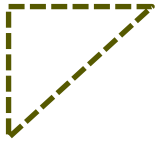
Various ways to compare historical and modelled rates of change:

- Compare the slopes / rates of change of various periods in time
- Deduct the duration
- Deduct the extent of growth



Selected system change indicators that span over both historical and modeled data

- Annual added capacity



GW / yr

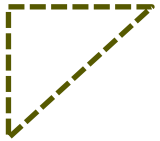
- Technology diffusion

No unit!

(Cumulative) capacity oriented

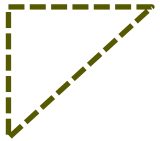
Technology-specific indicator

- Emission reduction rate



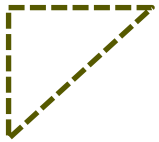
% / yr

- Supply-side investments

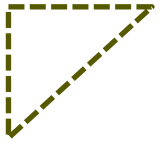
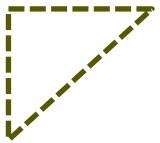


$ / yr

Selected system change indicators that span over both historical and modeled data

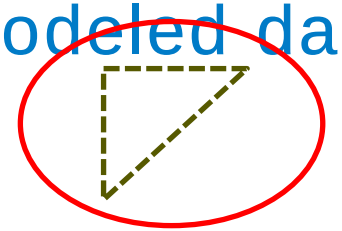
- Annual added capacity  **GW / yr**
- Technology diffusion  **No unit!**

System-wide (aggregated) indicators

- Emission decline rate  **% / yr**
- Supply-side investments  **$ / yr**

Selected system change indicators that span over both historical and modeled data

- Annual added capacity



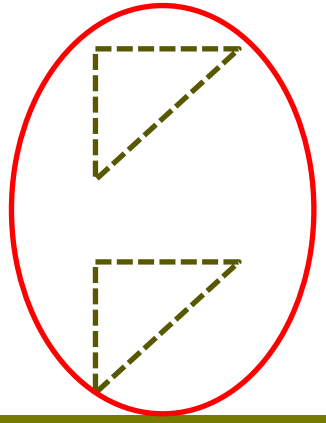
GW / yr

Annual change

- Technology diffusion

No unit!

- Emission decline rates



% / yr

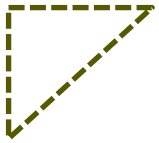
Annual change

- Supply-side investments

$ / yr

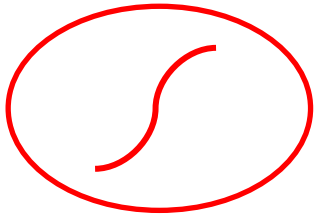
Selected system change indicators that span over both historical and modeled data

- Annual added capacity



GW / yr

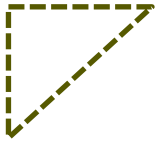
- Technology diffusion



Lifetime

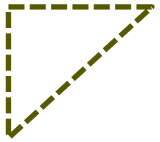
No unit!

- Emission decline rates



% / yr

- Supply-side investments



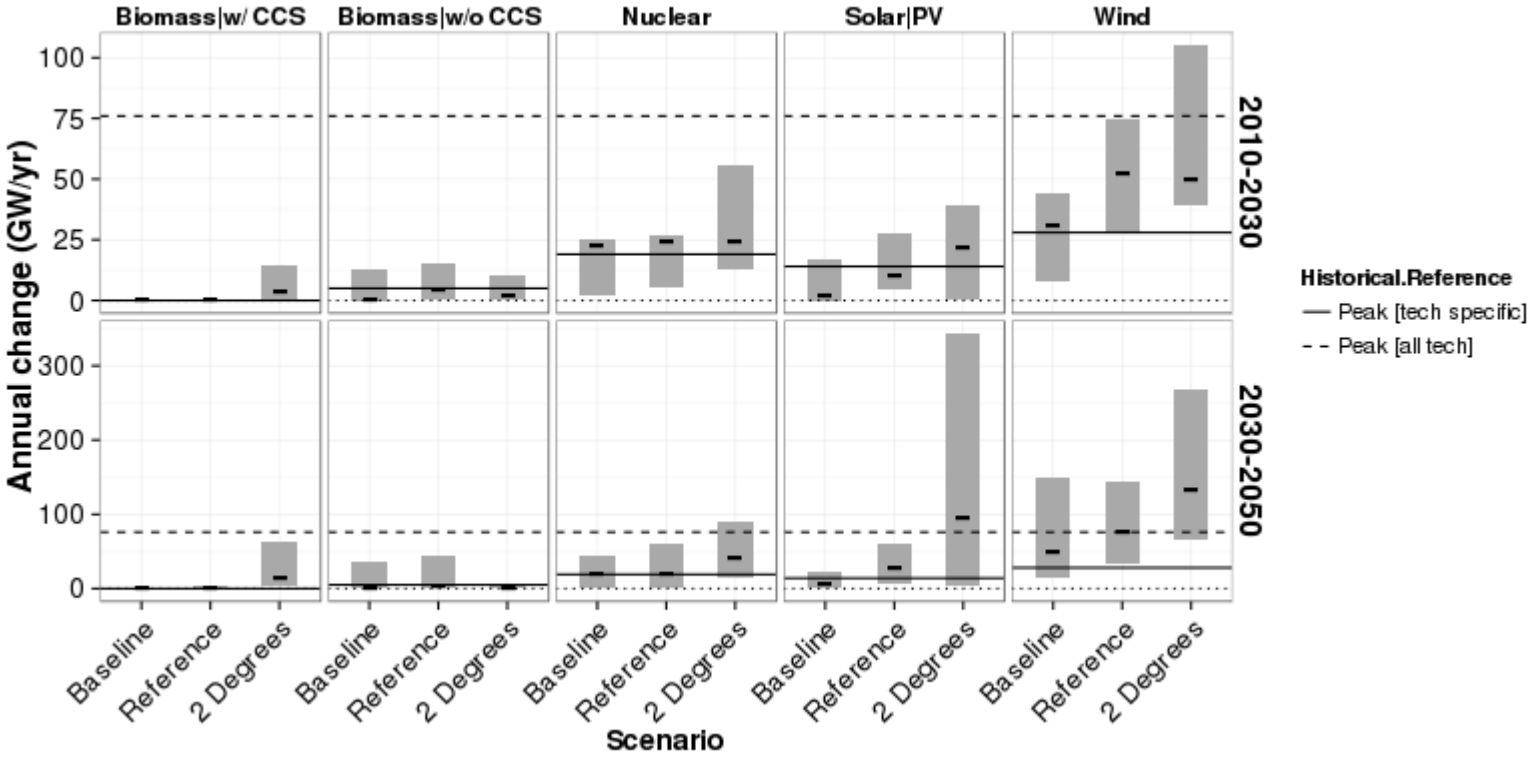
$ / yr

Various historical 'benchmarks'

(Annual capacity addition, GW/yr)

Reported frontier rate

- **Within reported historical rates**
- **Within overall system performance**
- **Beyond any current hist. reference**



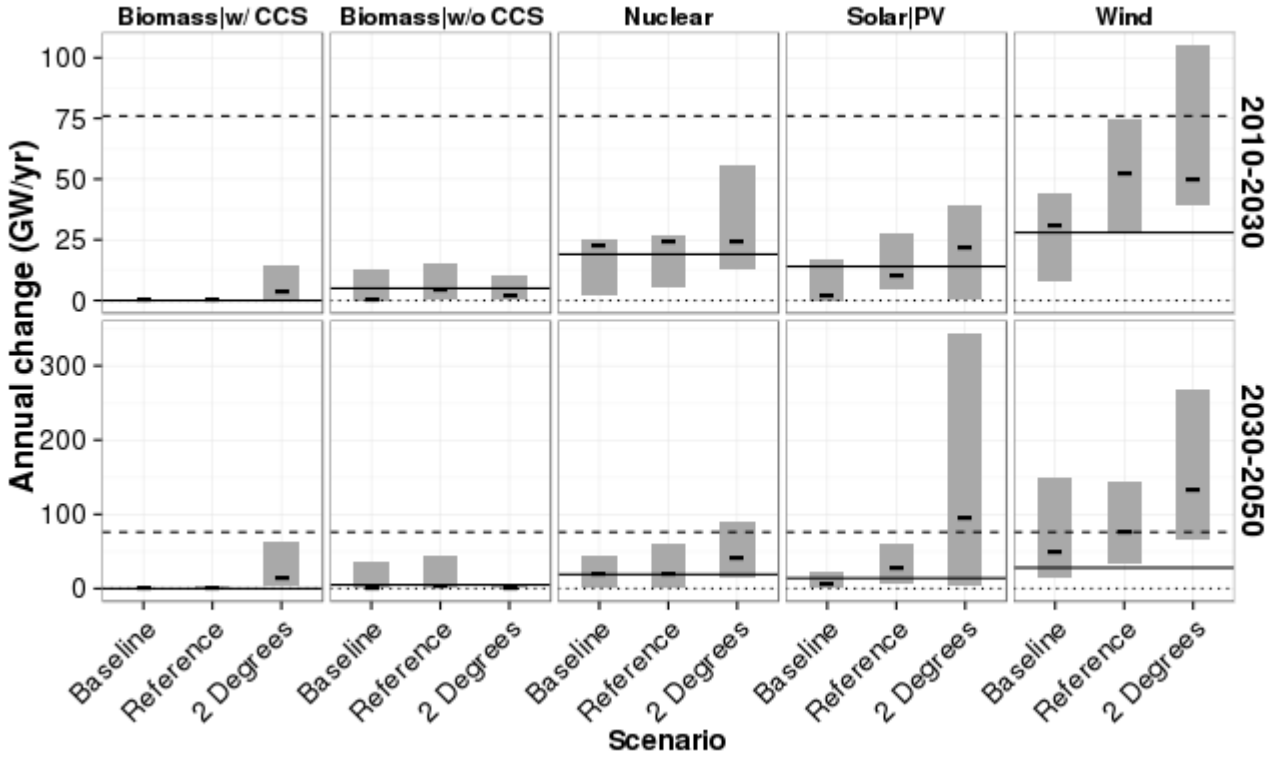
Various historical 'benchmarks'

(Annual capacity addition, GW/yr)

Within reported historical rates

Within overall system performance

Beyond any current hist. reference



Where applicable: a better frontier rate (expanded scope)

Various historical 'benchmarks'

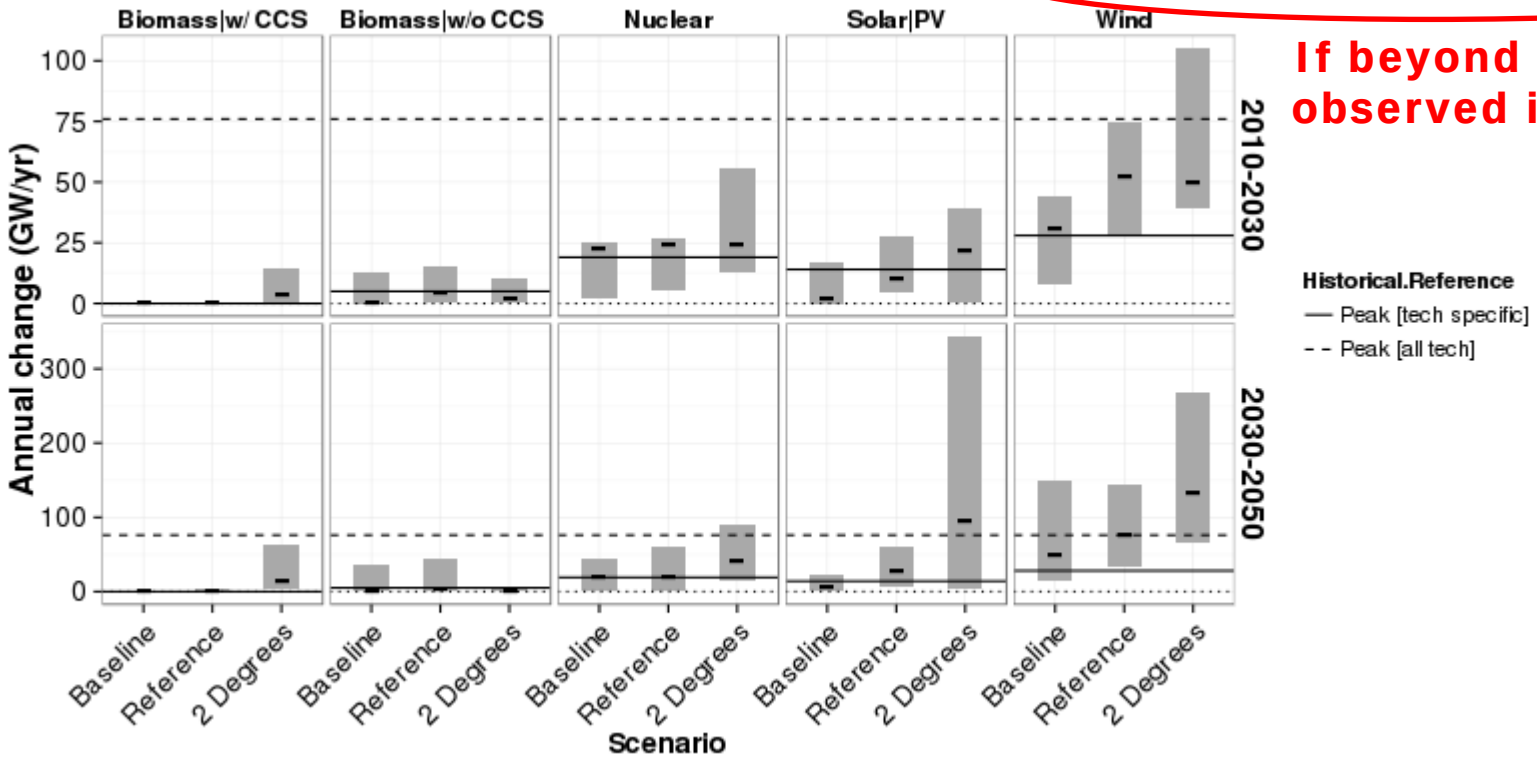
(Annual capacity addition, GW/yr)

Within reported historical rates

Within overall system performance

Beyond any current hist. reference

If beyond rates observed in history



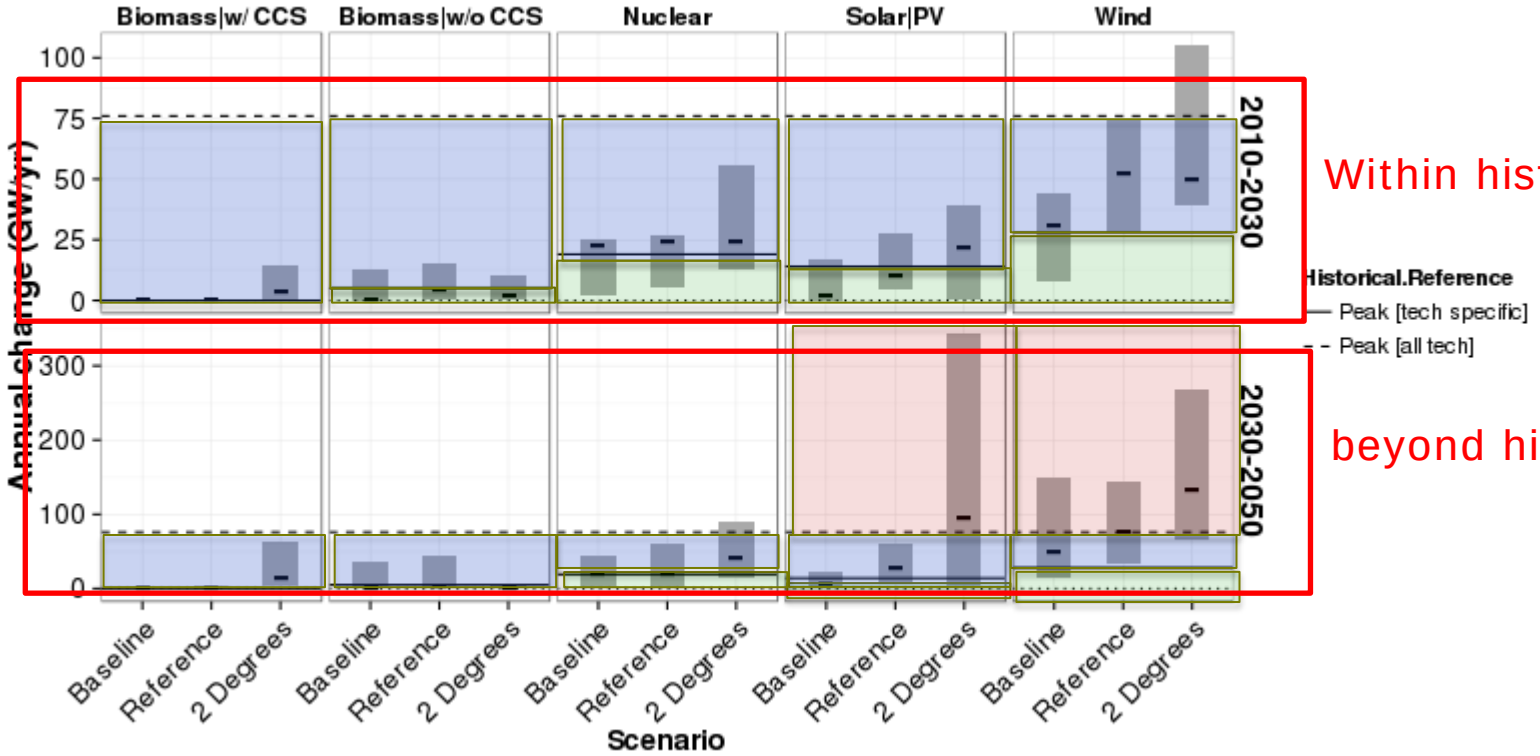
Example of testing indicators:

(Annual capacity addition, GW/yr)

Within reported historical rates

Within overall system performance

Beyond any current hist. reference



Within historical range

beyond historical range

Overview of the tested indicators

			Absolute growth		
			Baseline	Reference	2 Degrees
2010-2030	Average annual capacity additions	Renewables			
	Average annual emission decline rates	System			
	Average annual supply-side investments	System			
2030-2050	Average annual capacity additions	Renewables			
	Average annual emission decline rates	System			
	Average annual supply-side investments	System			
	Technology diffusion	Tech-specific			

For the observant spectator..

- The comparison of these "*absolute*" future rates with historical rates does not correct for:
  - the stage of development for specific technologies
  - Overall system growth

- **To correct for this we normalize by using a metric representing total system growth:**
  - Global GDP (in T$),
  - global primary energy demand (in EJ),
  - total electricity generation capacity (in GW)
  - total capital investments in the energy system (in billion USD$).

Normalized rates of change

			Normalized growth		
			Baseline	Reference	2 Degrees
2010-2030	Average annual capacity additions	Renewables			
	Average annual emission decline rates	System			
	Average annual supply-side investments	System			
2030-2050	Average annual capacity additions	Renewables			
	Average annual emission decline rates	System			
	Average annual supply-side investments	System			
	Technology diffusion	Tech-specific			

Recap/Conclusions

- **Absolute rates** of change become **rapid** in the medium term compared to historically achieved rates of change (2°C context).

- **Relative rates** of change by comparing the change to overall growth in the system conclude that future rates of change are generally **within the range** of successful transitions in the past.

Conclusions

- No conclusive set of indicators: outcomes swing both ways

- The “achievability” of future rates of change **depends** on:
  1. The indicator used
  2. Scope of historical benchmark (selective bias)
  3. Normalization and metric used for total system growth,
  4. Data availability
  5. Models included

- Using a wide set of indicators proves to be useful to:
  - contribute to scenario evaluation
  - offers alternative, complementary insights
  - provoke critical interpretation of results.

Thank you for your attention!

TRANSITION PATHWAYS TO SUSTAINABLE LOW-CARBON SOCIETIES

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