

# Constructing a Roadmap

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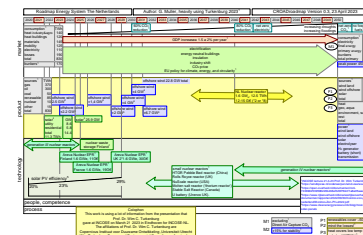
## Abstract

In this presentation, we show how to construct a roadmap. The Dutch energy system is taken as an example.

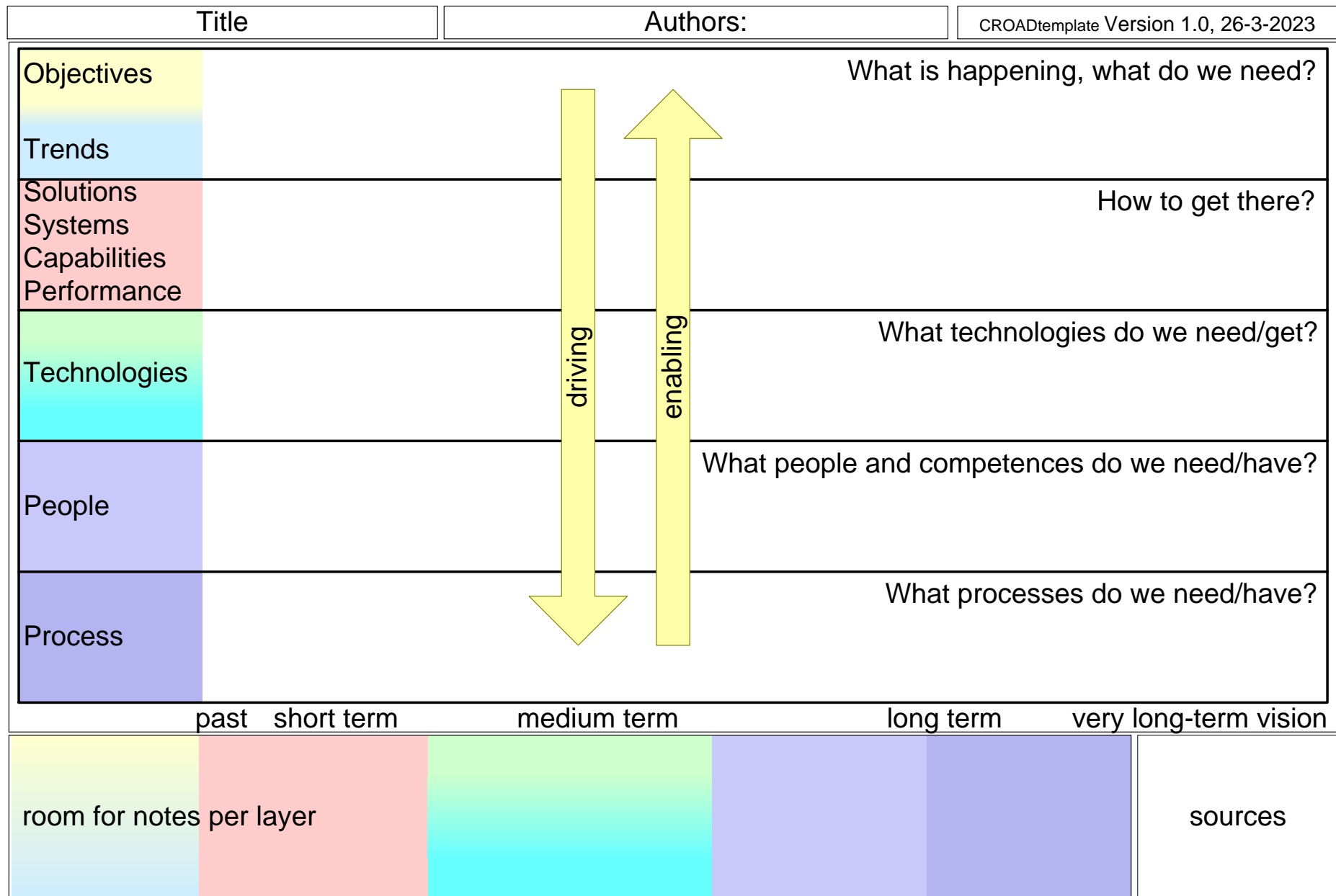
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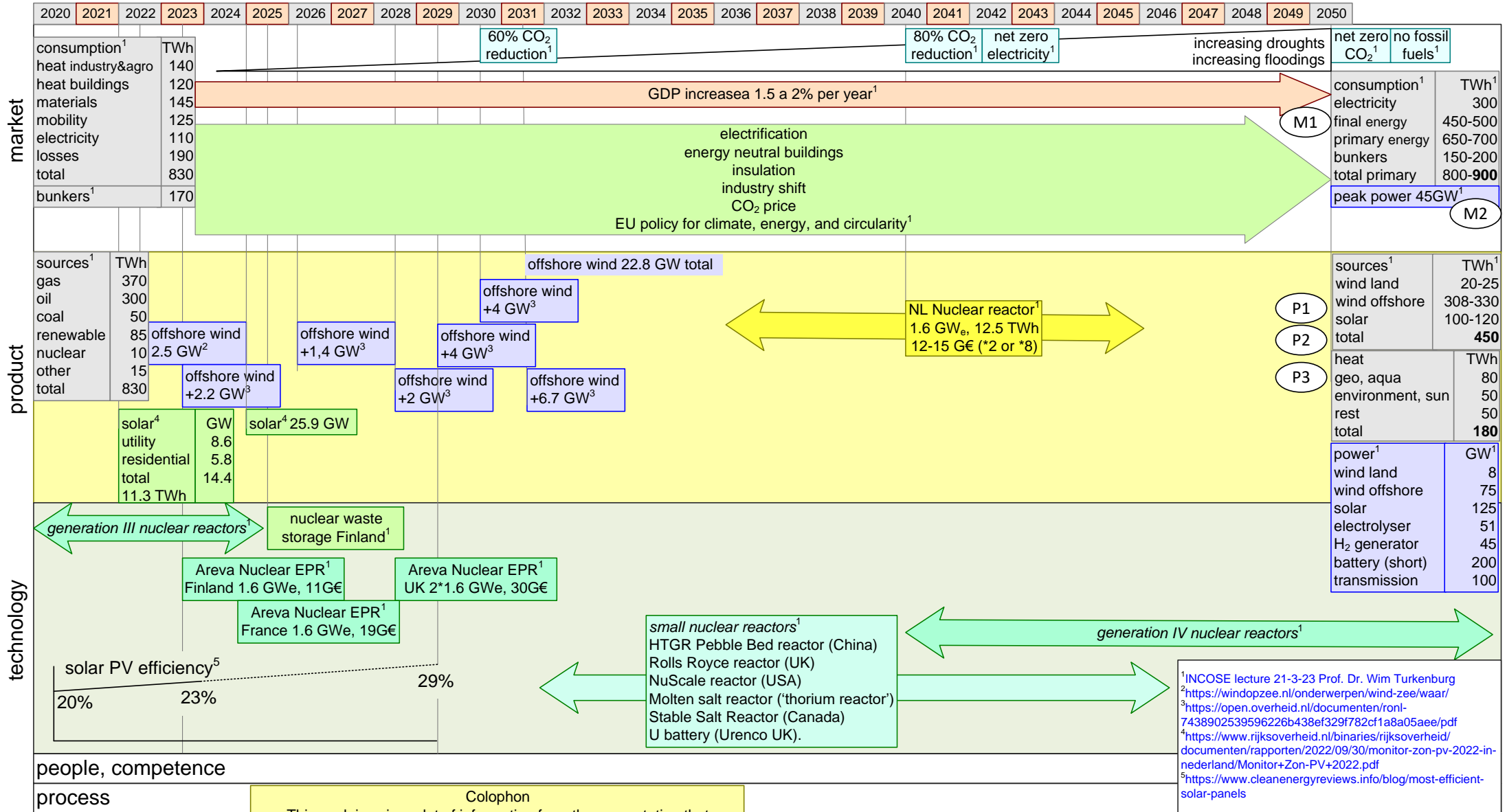
# A Roadmap Provides a Single Page Overview



## Colophon

This work is using a lot of information from the presentation that  
Prof. Dr. Wim C. Turkenburg  
gave at INCOSE on March 21 2023 in Eindhoven for INCOSE-NL.

The affiliations of Prof. Dr. Wim C. Turkenburg are  
Copernicus Instituut voor Duurzame Ontwikkeling ,Universiteit Utrecht  
(Copernicus Institute for Sustainable Development, University Utrecht)  
and  
Wim Turkenburg Energy and Environmental Consultancy, Amsterdam



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M1 excluding<sup>1</sup> Direct Air Capture CO<sub>2</sub>

M2 +15% for stability<sup>1</sup>

P1 renewables cover ~50%<sup>1</sup>

P2 mind the losses!<sup>1</sup>

P3 heat covers low temp needs only (<<100TWh)<sup>1</sup>

<sup>1</sup>INCOSE lecture 21-3-23 Prof. Dr. Wim Turkenburg  
<sup>2</sup><https://windopzee.nl/onderwerpen/wind-zee/waar/>  
<sup>3</sup><https://open.overheid.nl/documenten/ronl-7438902539596226b438ef329f782cf1a8a05aee/pdf>  
<sup>4</sup><https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2022/09/30/monitor-zon-pv-2022-in-nederland/Monitor+Zon-PV+2022.pdf>  
<sup>5</sup><https://www.cleanenergyreviews.info/blog/most-efficient-solar-panels>

2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050

market

60% CO<sub>2</sub> reduction<sup>1</sup>

80% CO<sub>2</sub> reduction<sup>1</sup>

net zero electricity<sup>1</sup>

increasing droughts  
increasing floodings

net zero CO<sub>2</sub><sup>1</sup> no fossil fuels<sup>1</sup>

GDP increase a 1.5 a 2% per year<sup>1</sup>

electrification  
energy neutral buildings  
insulation  
industry shift  
CO<sub>2</sub> price  
EU policy for climate, energy, and circularity<sup>1</sup>

product

technology

people, competence

process

<sup>1</sup>INCOSE lecture 21-3-23 Prof. Dr. Wim Turkenburg

<sup>2</sup><https://windopzee.nl/onderwerpen/wind-zee/waar/>

<sup>3</sup><https://open.overheid.nl/documenten/ronl-7438902539596226b438ef329f782cf1a8a05aee/pdf>

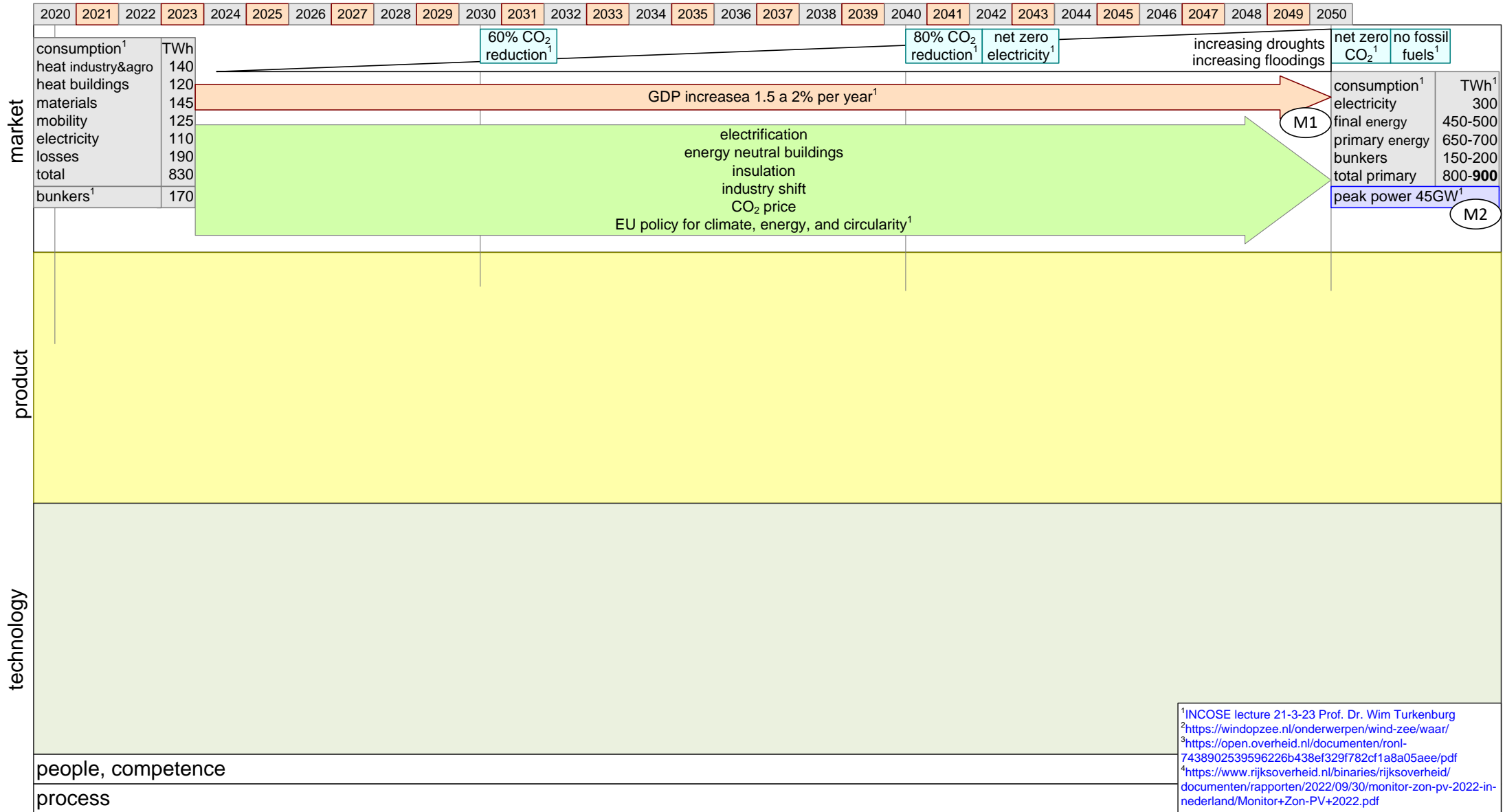
<sup>4</sup><https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2022/09/30/monitor-zon-pv-2022-in-nederland/Monitor+Zon-PV+2022.pdf>

Determine the long-term objectives

List the major relevant trends in the context

Make them specific

Quantify them (order of magnitude), as-is and to-be

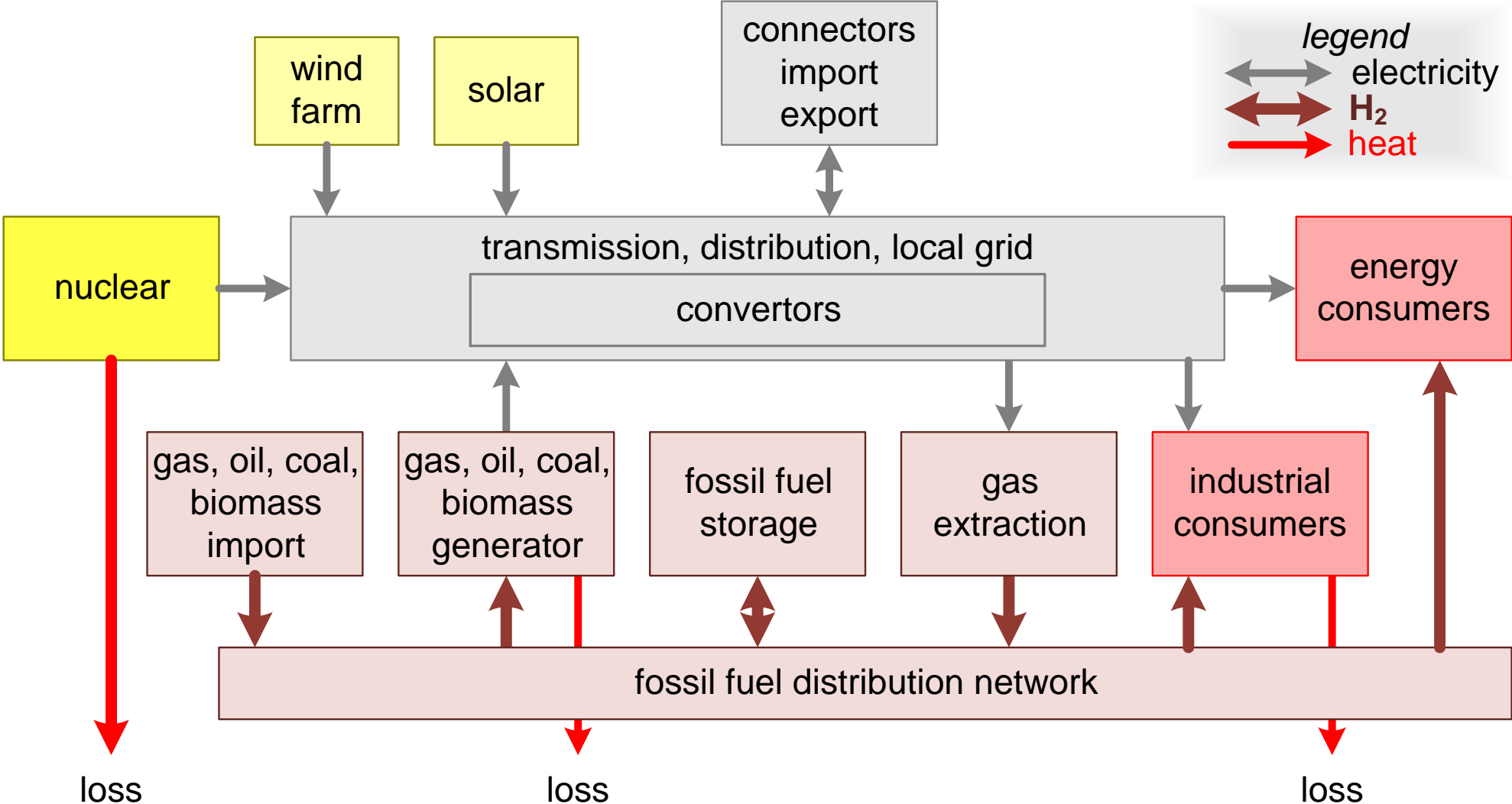


M1 excluding<sup>1</sup>  
Direct Air Capture CO<sub>2</sub>

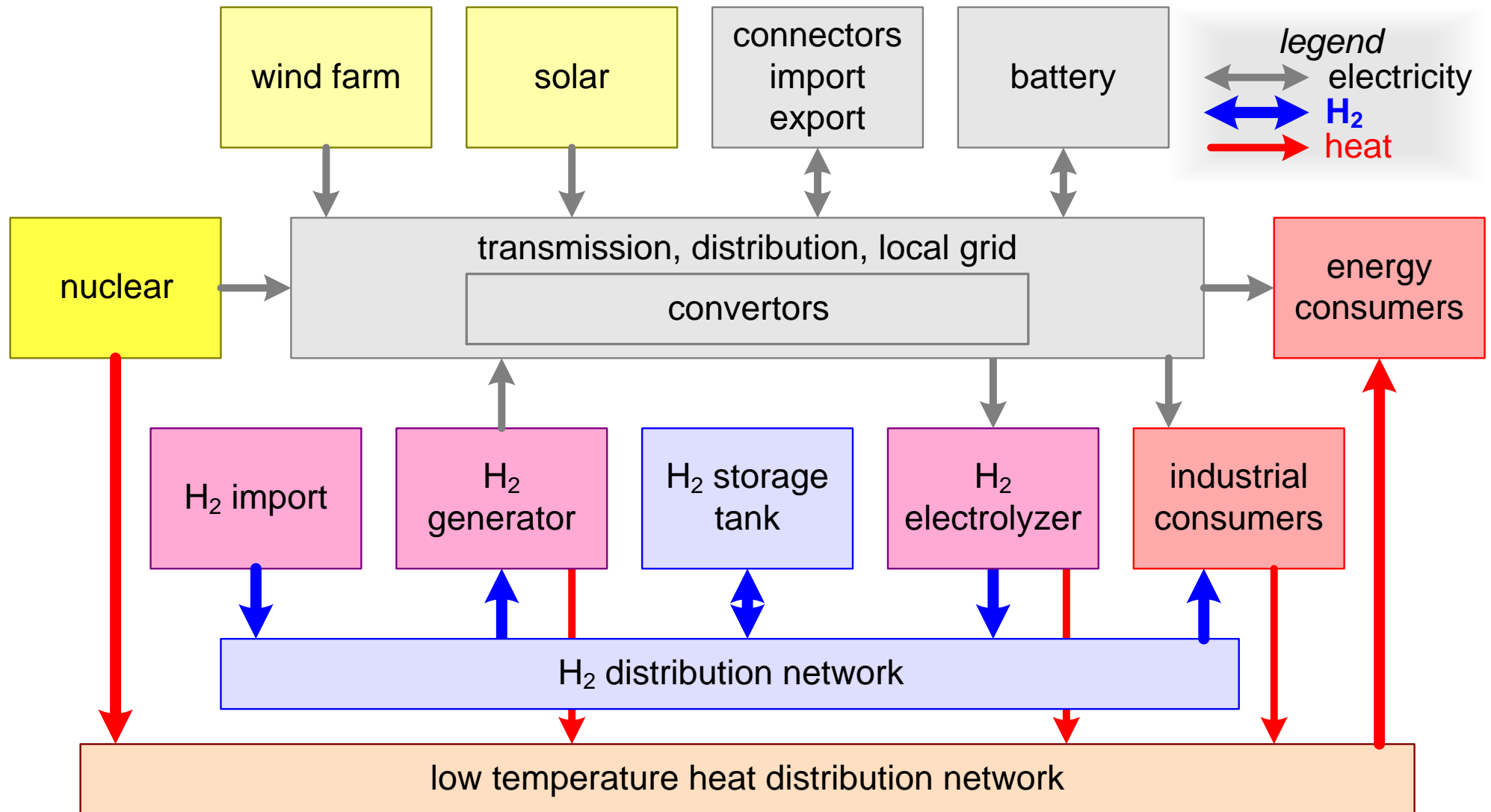
M2 +15% for stability<sup>1</sup>

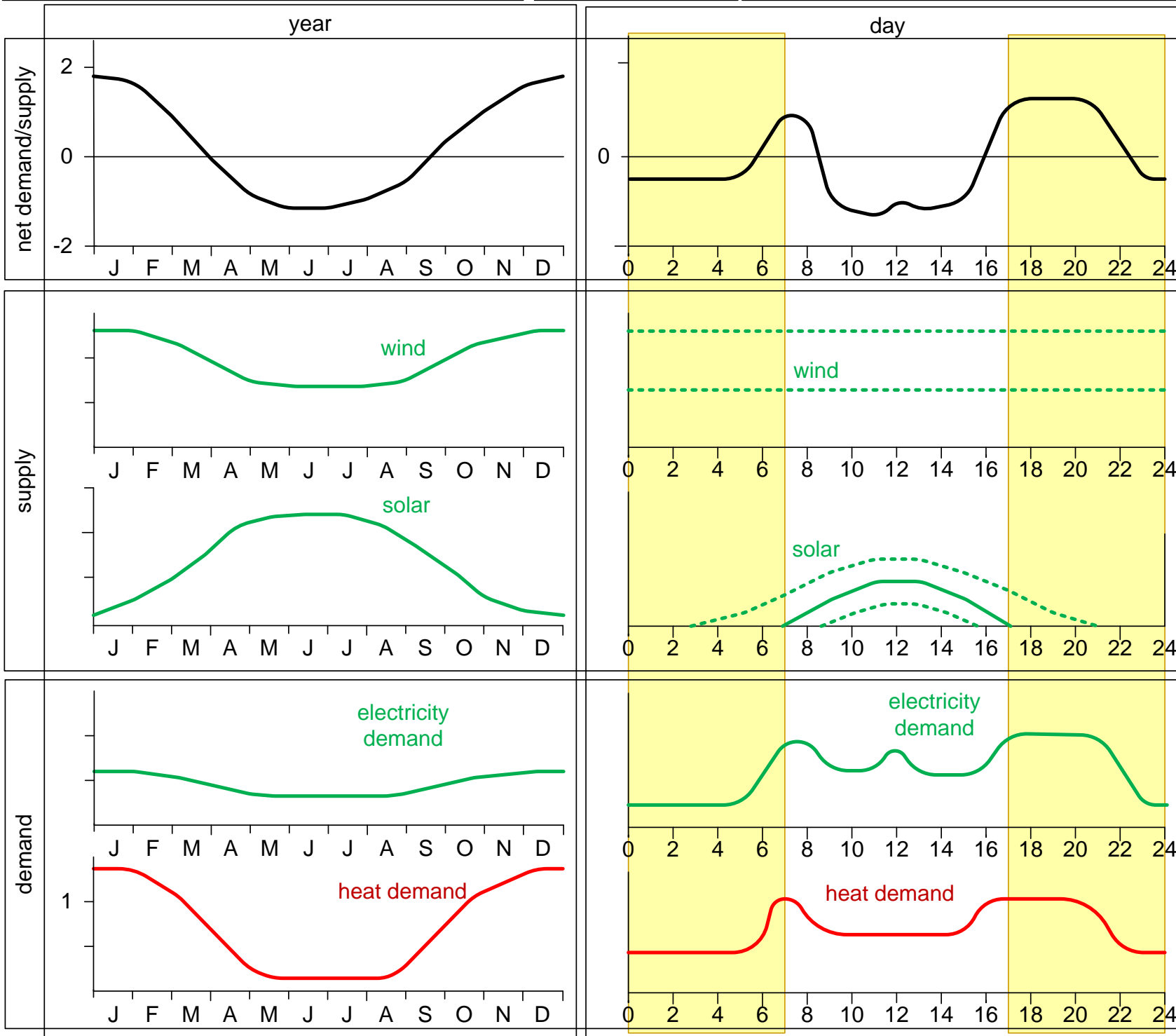
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# Block Diagram Past Energy System

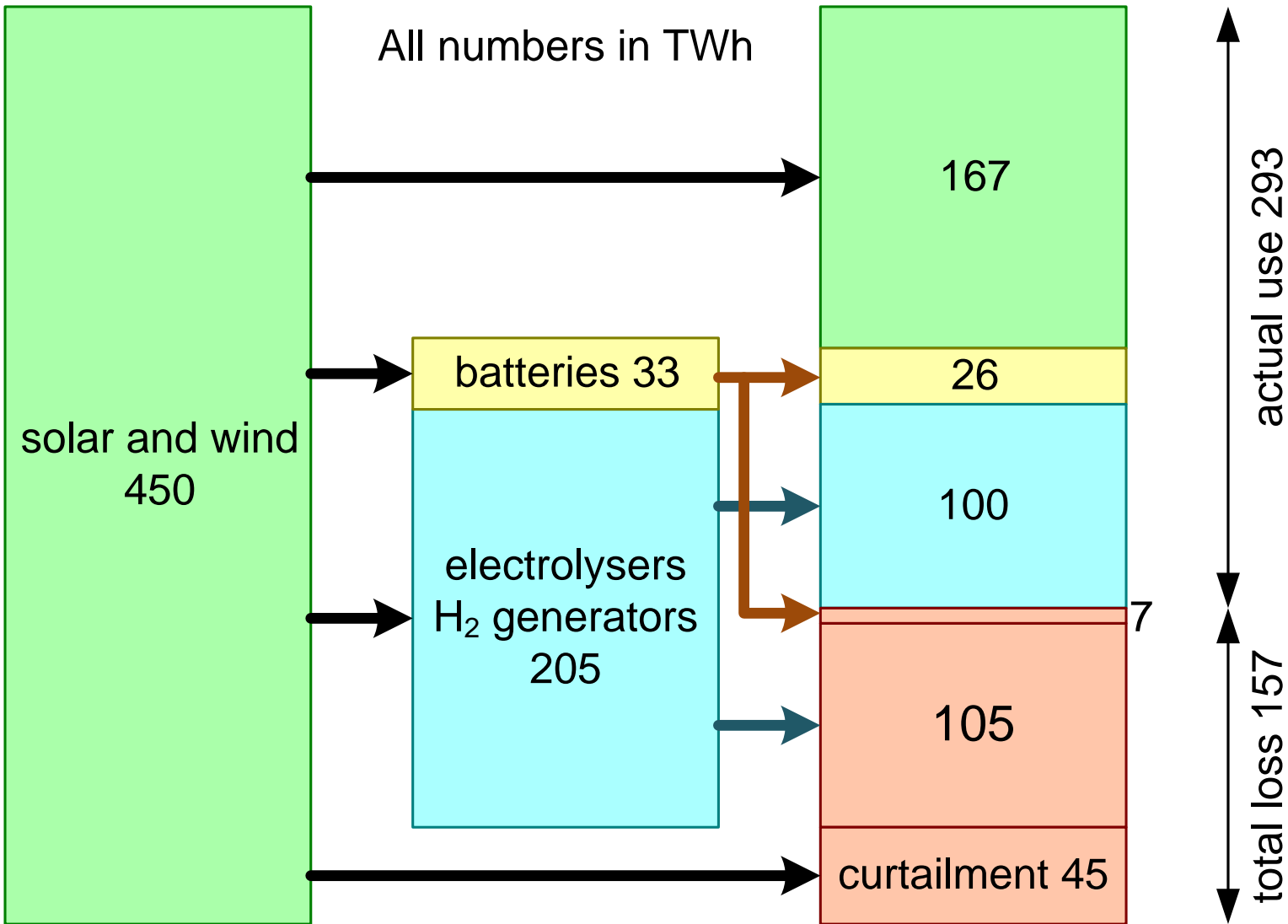


# Block Diagram Future Energy System

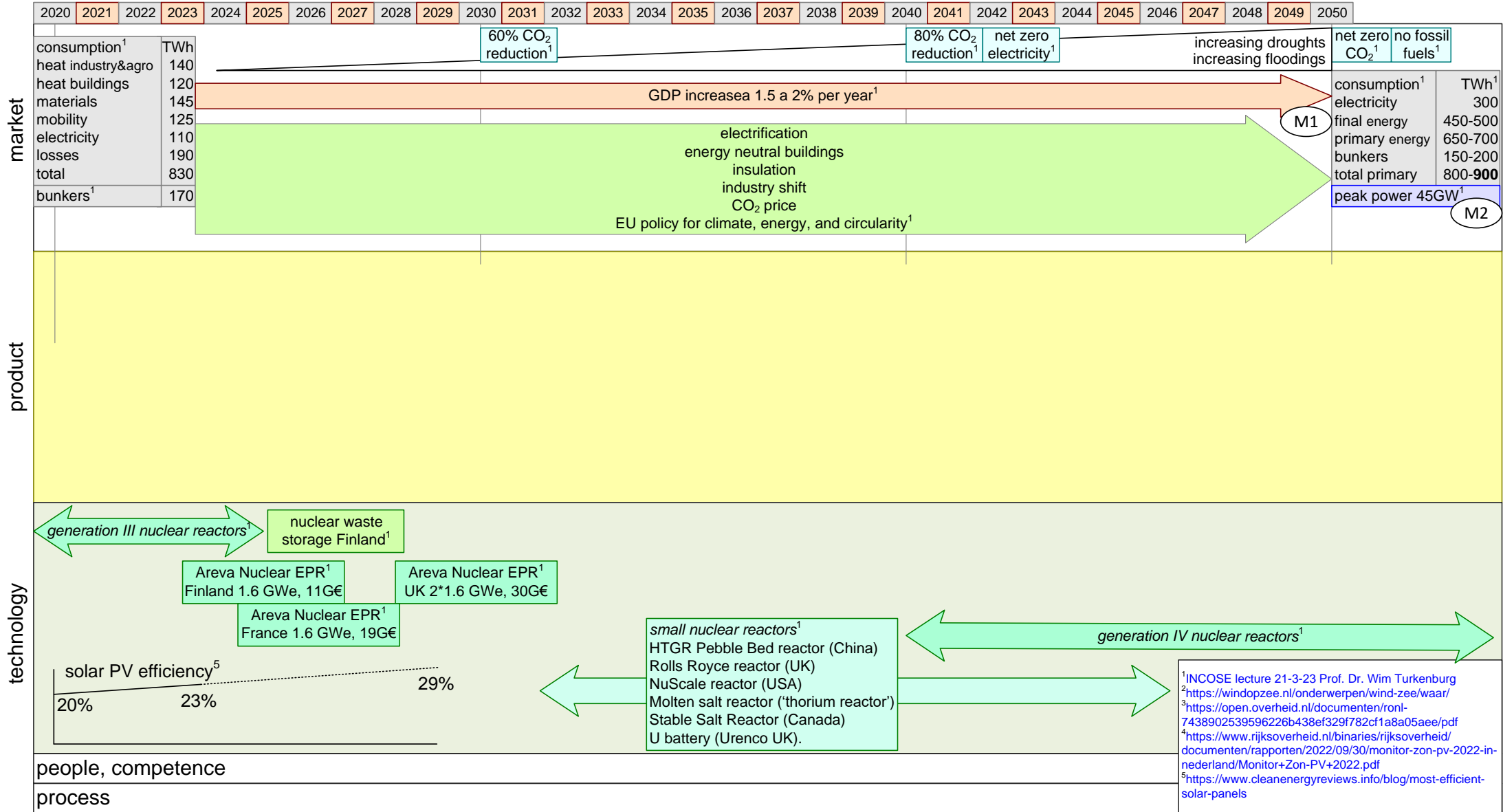




# Local Energy; 30% Loss!



data from INCOSE lecture 21-3-23 Prof. Dr. Wim Turkenburg



M1 excluding<sup>1</sup> Direct Air Capture CO<sub>2</sub>  
 M2 +15% for stability<sup>1</sup>

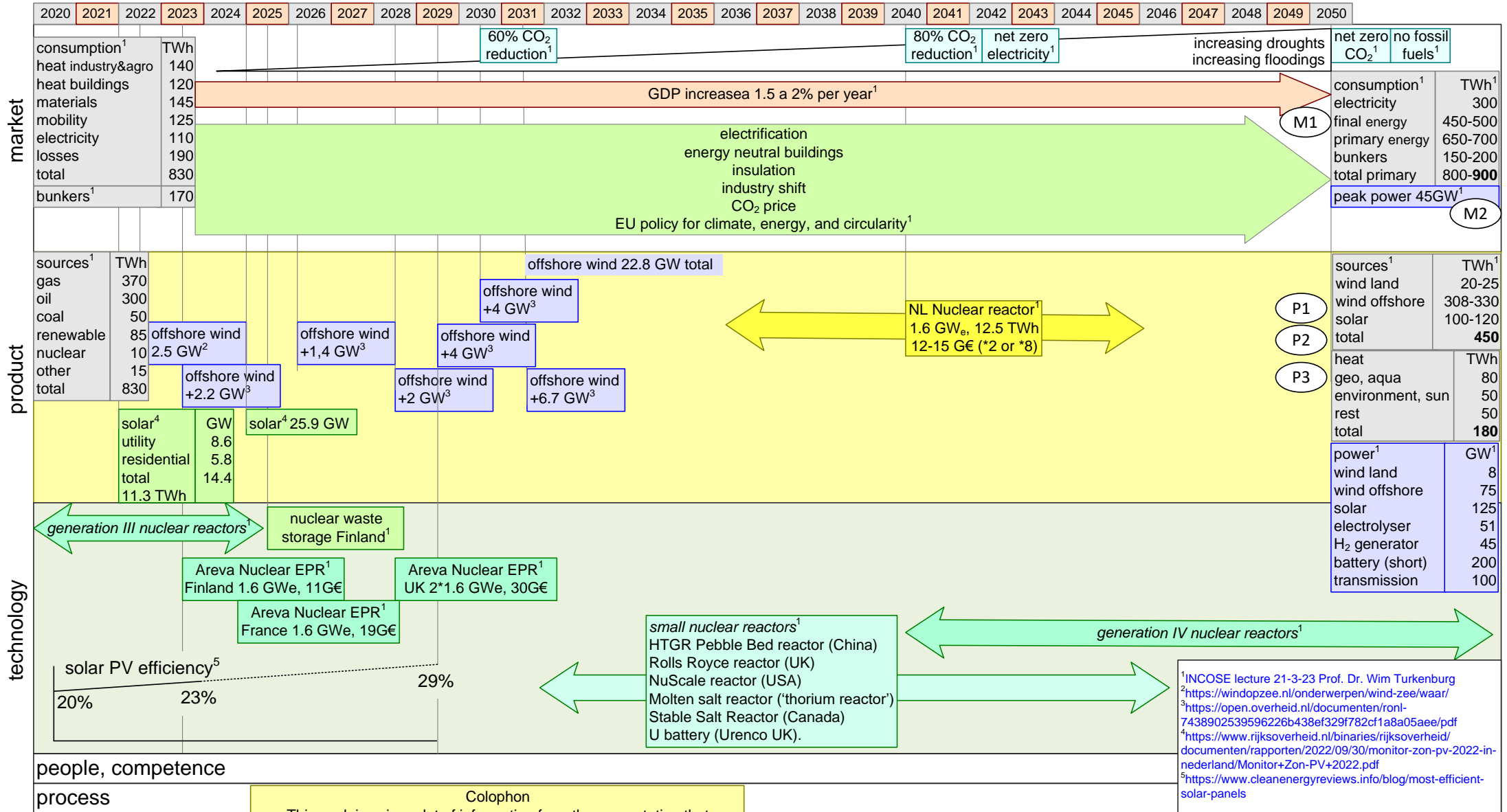
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 P2 mind the losses!<sup>1</sup>  
 P3 heat covers low temp needs only (<<100TWh)<sup>1</sup>

List the major relevant trends in the technology

Make them specific

Quantify them (order of magnitude), as-is and to-be

When stuck start sketching solutions and how they work.



## Step 3: Product/Solutions Layer

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List the solutions that the organization is working on or is planning (short-term)

Make them specific (features, performance, qualities)

Identify future solutions that fit the trends and objectives

Make them specific