



Universiteit Utrecht



Low-carbon energy supply

Options, potentials and costs, and other aspects

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KiVi EnergyNL2050

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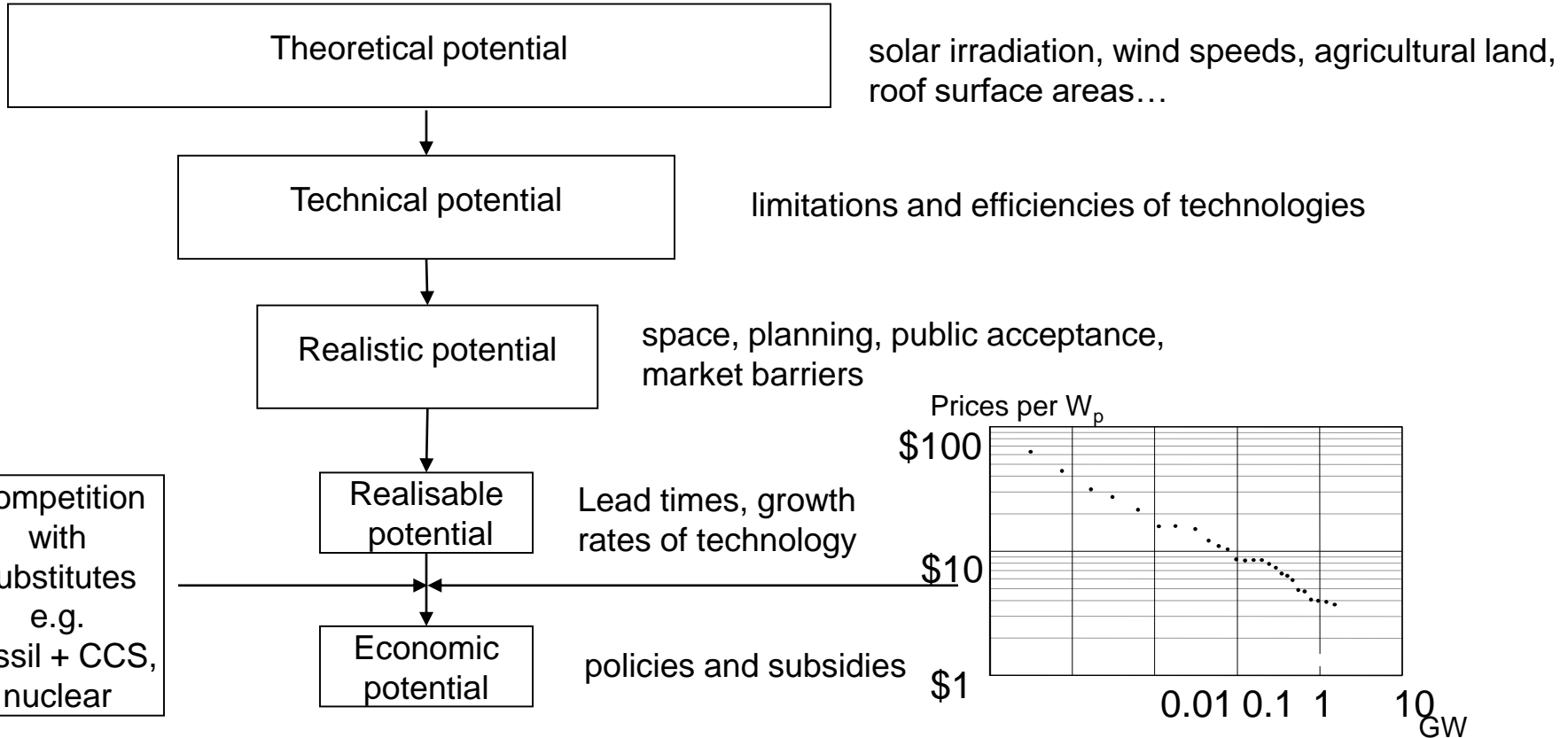


Key messages

1. Large potentials in NL for renewables and other low-carbon energy supply
2. Partly uncertain, partly costly, partly import-dependent
3. It's not only potentials and costs that will shape our 2050 energy economy

1. Low-carbon energy supply options: potentials

There's potentials and potentials...



Global biomass potentials

Issue/effect	Importance	Impact on biomass potentials
Improvement of agricultural management	***	↑↓
Food demand and human diet	***	↑↓
Use of degraded land	***	↑↓
Competition for water	***	↓
Perspective of aquatic biomass	***	↑
Use of agriculture/forestry by-products	**	↑↓
Expansion of protected areas	**	↓
Improvements in water use efficiency	**	↑
Climate change	**	↑↓
Alternative protein chains	**	↑

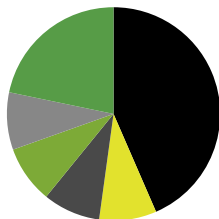
very, very uncertain...

Biomass potentials for NL

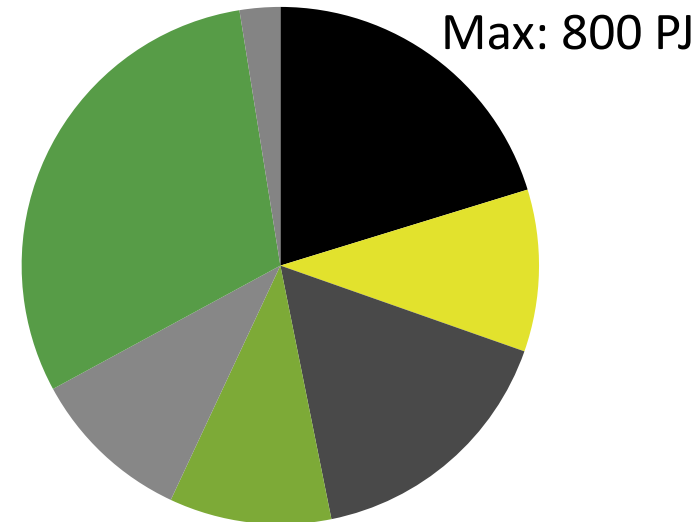
- NL share of global potential?
- Link with many other policy domains
 - Agriculture, forestry, rural development
 - Legal safeguarding, land rights
 - Food and diet habits

Allocation rule	Share for NL 2030
Per capita	~0,25%
Per TPES	~0,5%
Per GDP	~1%

Min: 100 PJ



- Agriculture: wet
- Agriculture: dry
- Agriculture: crops
- Wood: Sawdust, demolition
- Wood: Forestry residues
- Wood: Additional production
- Aquatic biomass

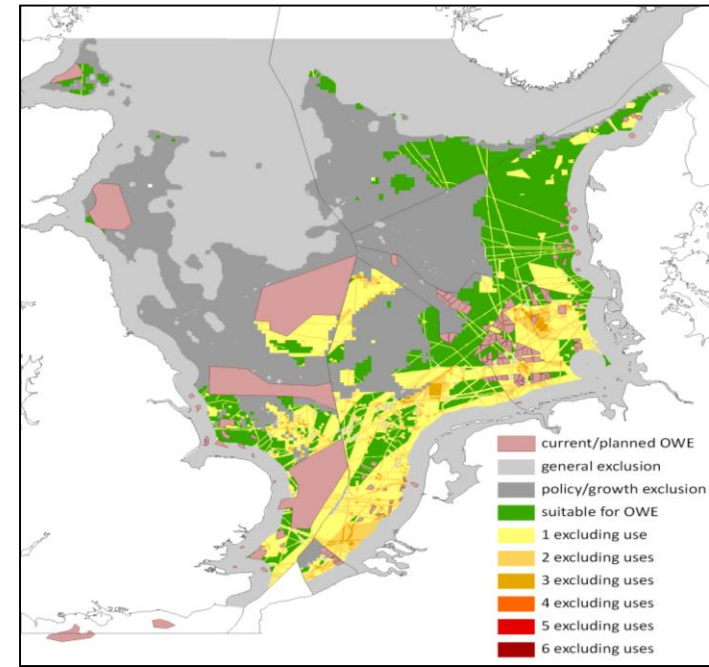


Wind potentials

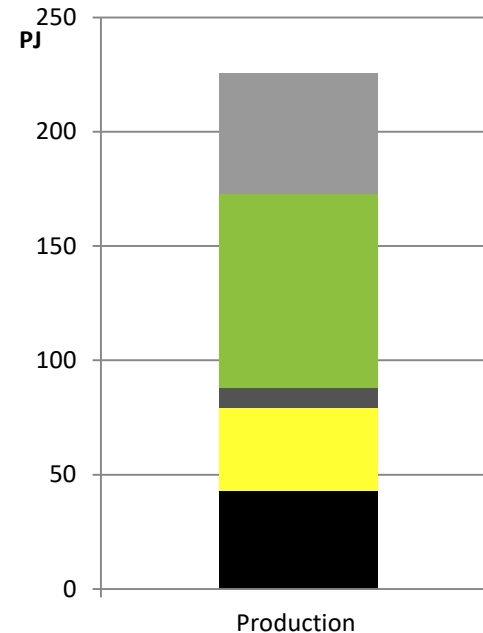
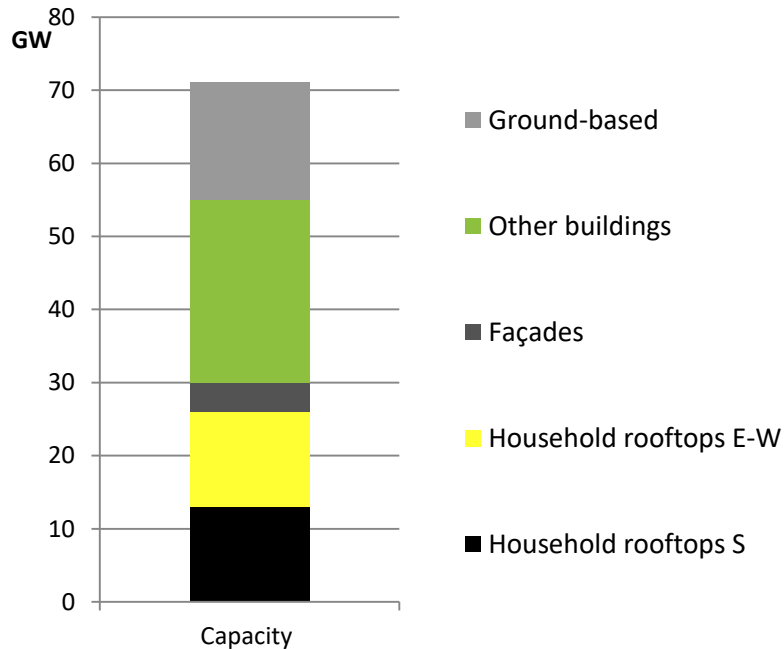
	On-shore		Offshore	
	Pessimistic	Optimistic	Pessimistic	Optimistic
Potential capacity (GW)	7	9	18	35
Potential production (PJ)	45	90	250	550
Current production (2015, PJ)	21		4	

Where would all this offshore wind potential be?

- Yield densities: now 6 GW/km²
 - Higher yields possible?
 - If you realise more offshore wind, slightly lower (wake effects)
-
- Current locations: ~15 GW
 - Borssele,
 - Hollandse kust
 - IJmuiden ver
 - North from Wadden Sea
 - Then: areas further than “IJmuiden ver”
 - Then: Doggersbank



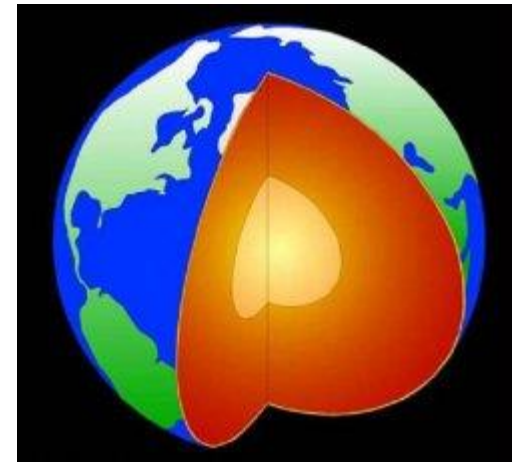
Solar-PV potentials



... and of course some solar thermal, ~50 PJ

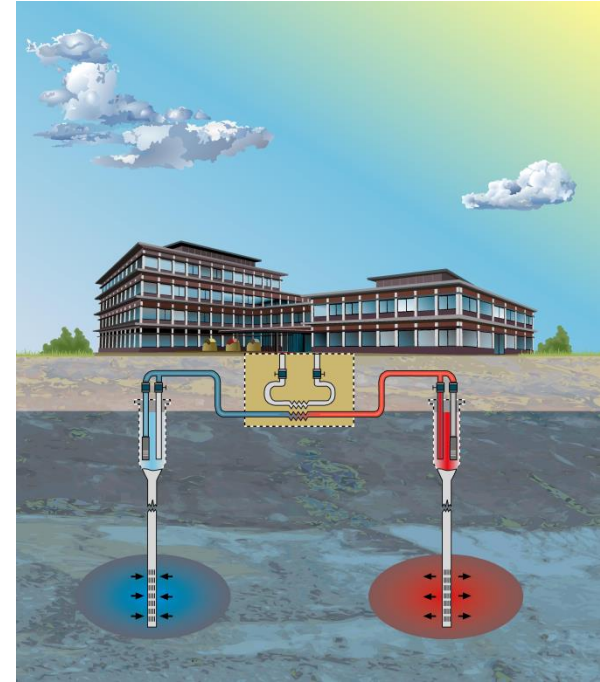
Geothermal

- The deeper, the hotter
- Conventional geothermal (heat): ~150 PJ
- (Ultra)deep geothermal (heat, power) several 100's of PJ



Storage of heat and cold (WKO-WP)

- ... not limited by the availability of buffer capacity...
- Particularly relevant for services sector and newly built dwellings
- Potential ~50 PJ



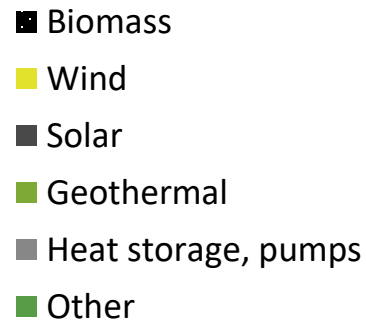
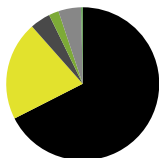
The renewable dark horses...

- Wave and tidal energy
 - Blue energy (osmosis)
 - Hydro power water stream energy
- No enormous potentials expected for the Netherlands

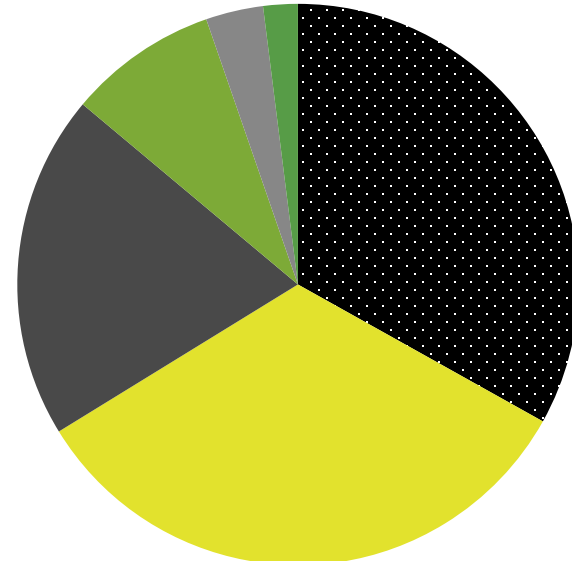
Total potentials of renewables

- Partly 'primary': biomass
- Partly 'final': wind, solar, geothermal
- Import from wind, solar?

Actual 2015 (final):
120 PJ



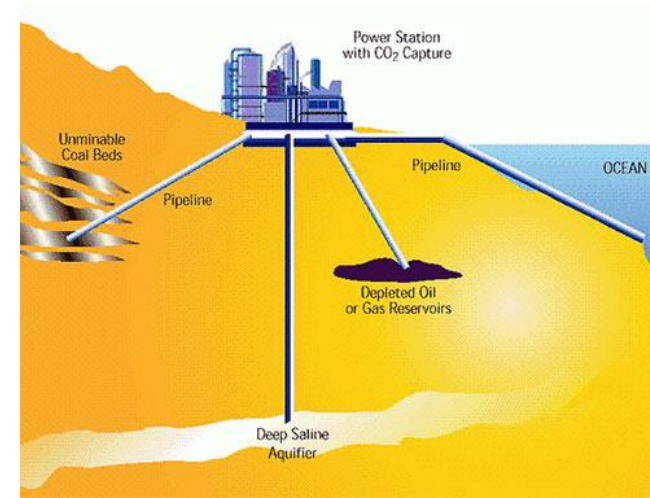
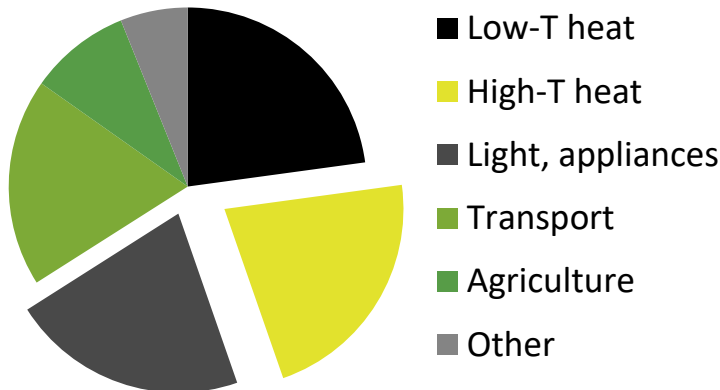
Potential 2050 (final):
~1500 PJ



Other CO₂ mitigation options in the energy domain: CCS

- Relatively large potential in the Netherlands
- Dependent on many factors still
- Indication: ~50 Mton CO₂/year
- Beware of energy penalties

Total GHG emissions: ~200 Mton/year



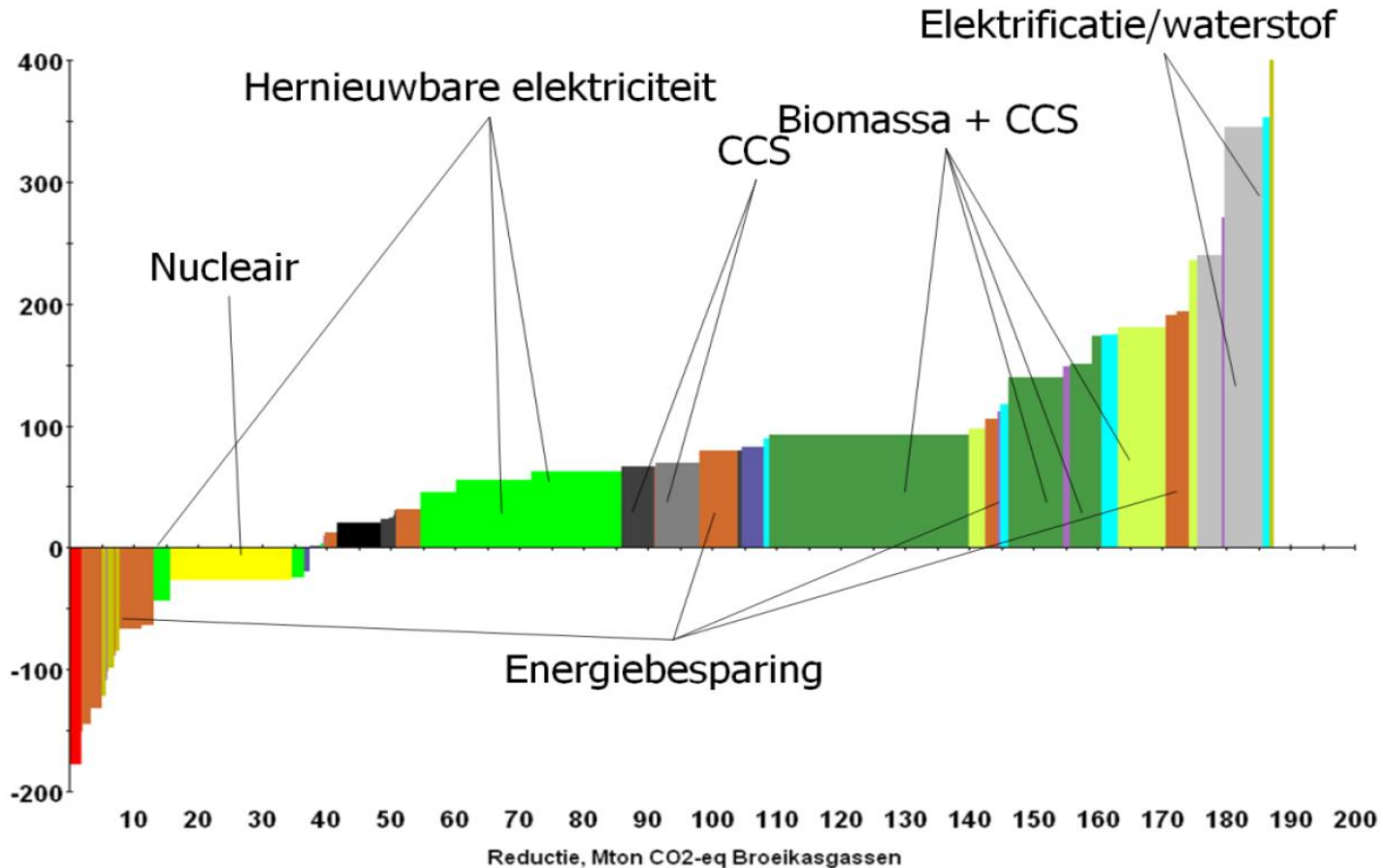
2. What about costs?

There's costs and there's costs...

- Commercial project costs
- Total system costs (commercial)
- National costs
- €/kWh, €/PJ
- €/tonne CO₂-eq



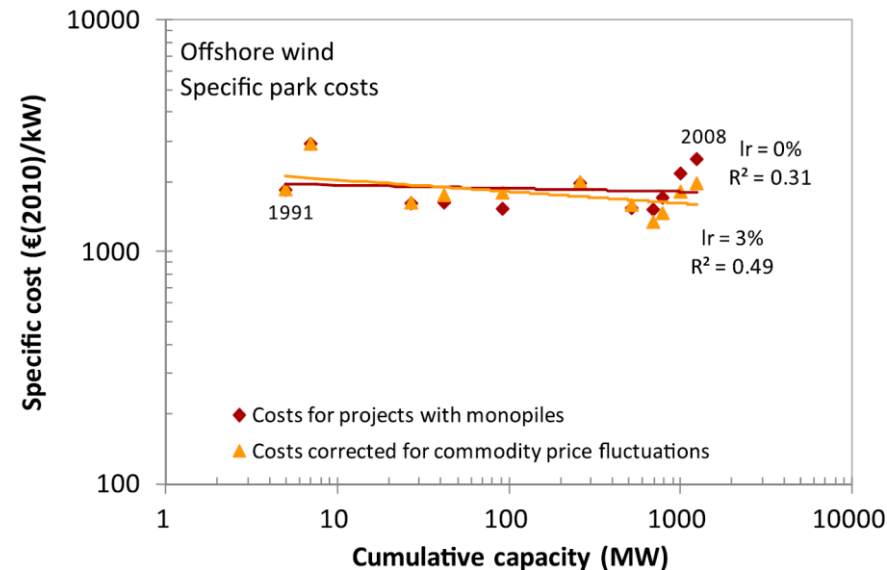
National costs of GHG mitigation: Renewables everywhere



What happened with offshore wind?

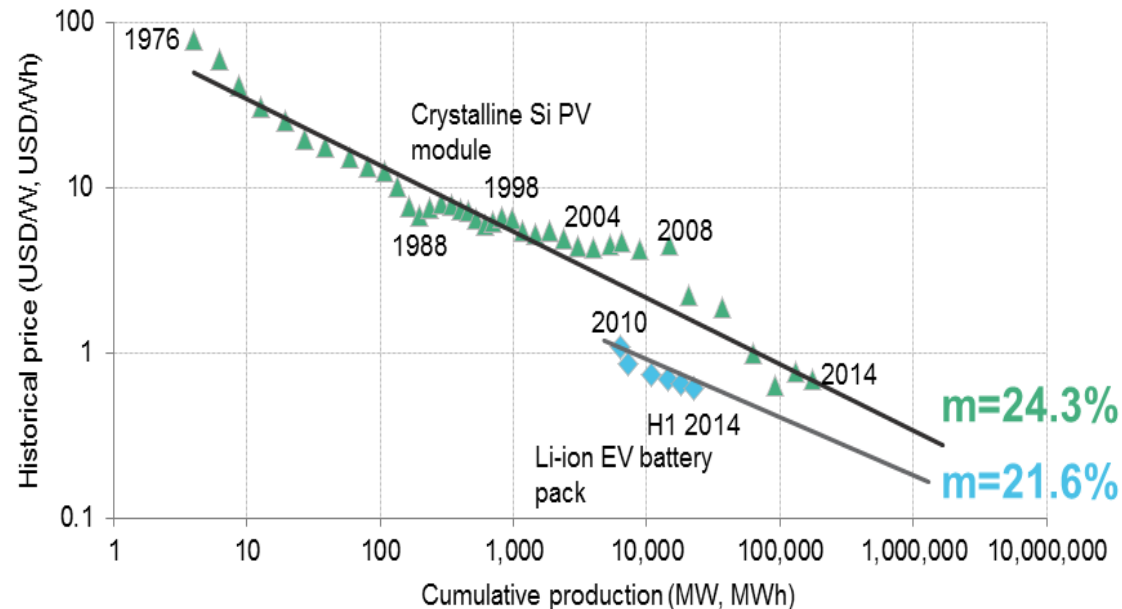
- From ~15 €/kWh to 5.5 €/kWh in three years!
- While in earlier years, cost reductions were very minor

- Innovation
 - Technical, in synergy with scale
 - Financial, etc.
- Socialisation:
 - Grid connection costs
 - Technical exploration of sites
- Conjunctural effects:
 - Steel prices
 - Recession in offshore fossil
 - Strategic behaviour and risk allocation



What happened with Solar-PV?


- In the Netherlands, competitiveness 'behind the meter' by 2013
- Strong growth in sunnier places
- 'Tilting point'



3. Why we will certainly *not* have the least-cost mix of supply options

It's the energy system, stupid!

- We need the right energy carriers, at the right time and place



	Electricity ↑	Heat ↑	Gaseous fuels ↓	Liquid fuels ↓
Biomass	X	X	X	X
Wind	X			
Solar	X			
Geothermal	x	X		

- Renewable power intermittency sets new challenges
- And for CCS, we need large-scale point sources of CO₂

It's public perception, stupid!



Wil jij ook je eigen energie opwekken?

Maar weet je niet waar je moet beginnen? Vraag gratis Zonnepanelen voor dummies aan!



Vraag hier je gratis exemplaar aan



It's instrumentability, stupid!

- “Ease of policy making” will vary widely
- As will political opportunities
- That's a fact of life

	'Policy ease'	Bio	Wind	Solar	Geoth	CCS
Length of supply chain	↓	☹	☺	☺	~	☹
Number of stakeholders involved	↓	☹	☺	☺	~	☹
Synergies with other domains	↑	☺	~	☺	~	☹
Conflicts with other domains	↓	☹	☹	☺	~	☹
Number of governmental layers	↓	~	~	☺	~	~
Issue complexity, information asymmetry	↓	☹	~	☺	~	☹

Thanks for your attention!

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