Deltares

Enabling Delta Life

Delta Scenarios NL

CHR – Spring seminar

“Socio-economic influences on the discharge of the River Rhine”

Bregenz, Austria, 26-27 March 2014

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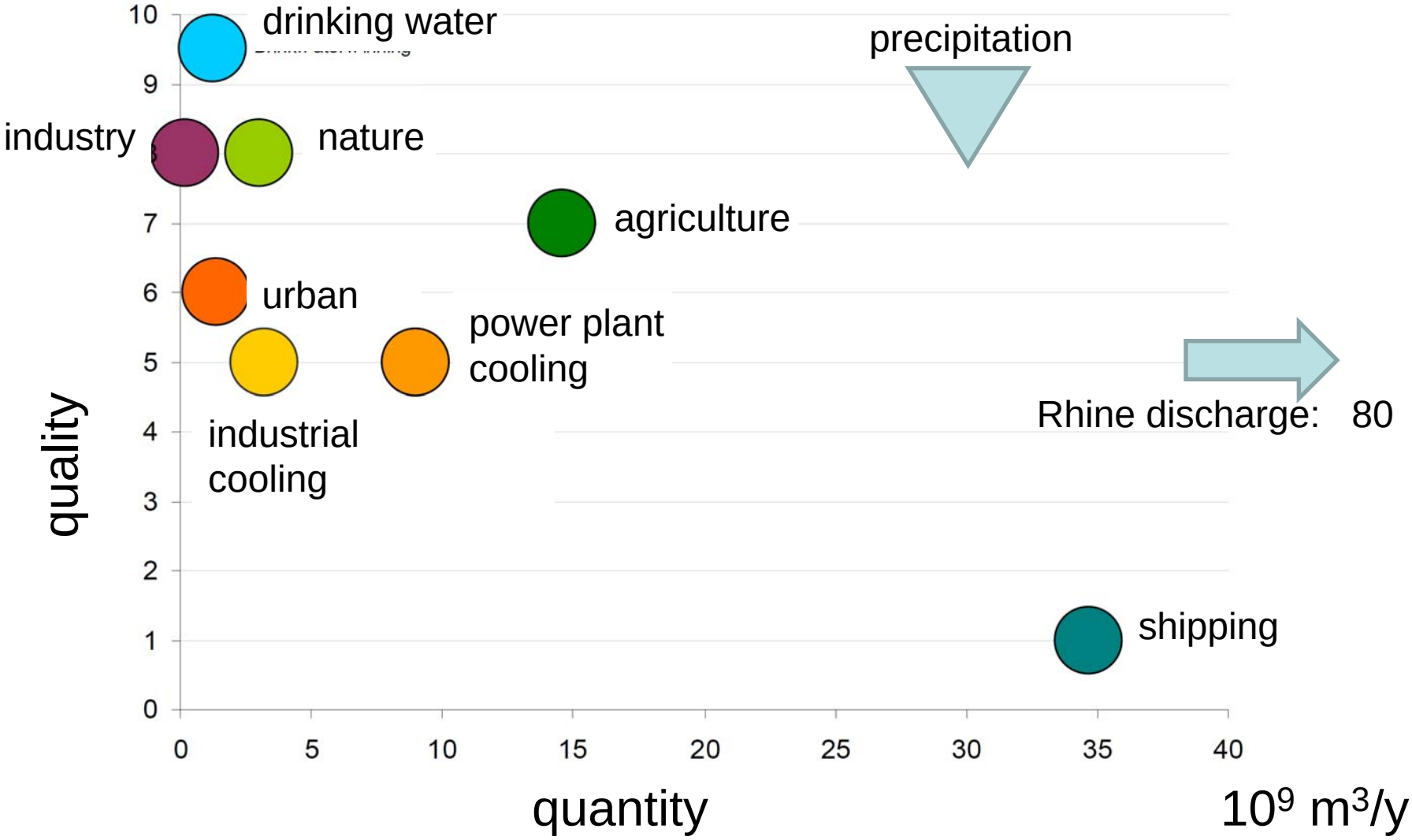
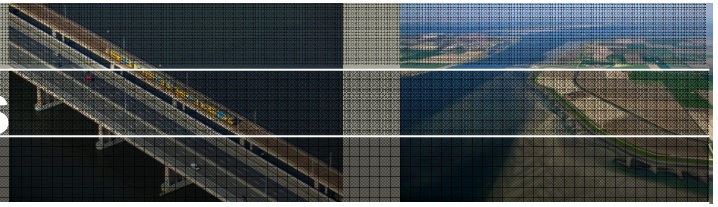
Water use in NL



Delta scenarios: requirements



- Integrating socio-economic developments and climate change
- Testing environment for the Dutch Delta Programme:
  flood protection, fresh water supply, spatial adaptation
  for 2015 →2050 → 2100

  What, if ….?
- Challenging & inspiring: key words, story lines, pictures, maps
- Quantitative: combining existing scenarios & models,
  producing detailed figures for river flow extremes and land use
- NL in the context of W-EU, global developments

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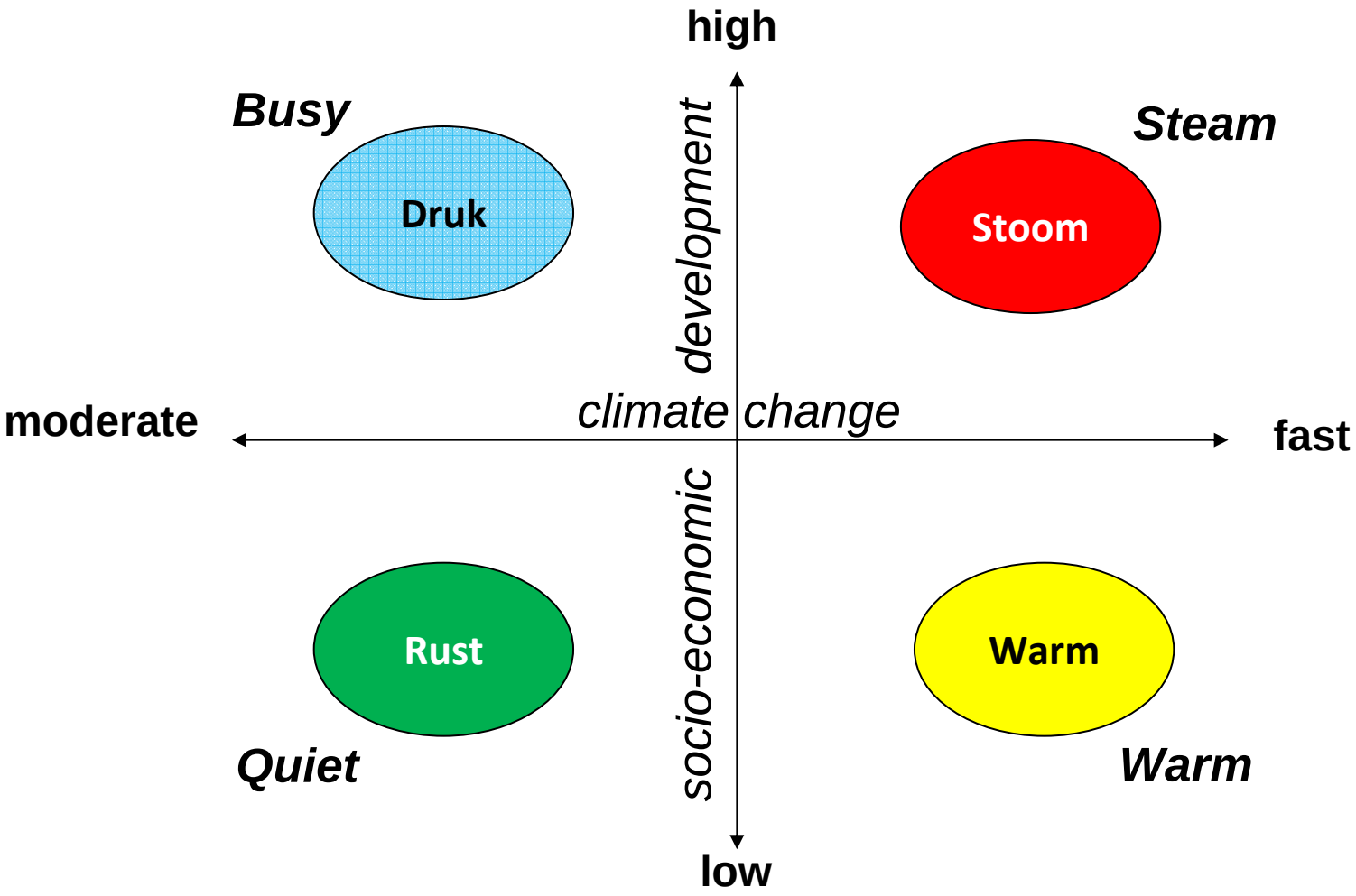
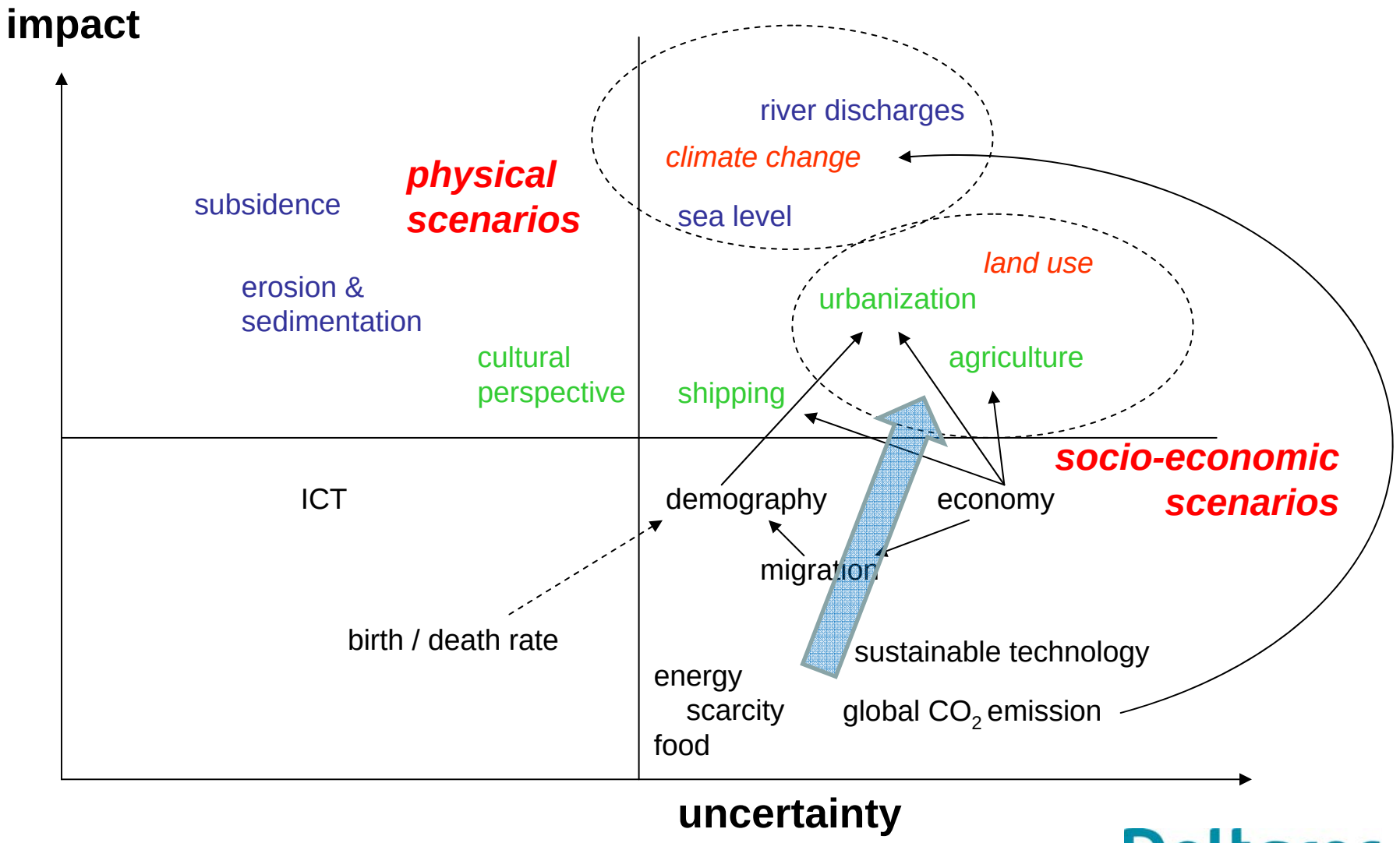
Four DeltaScenarios



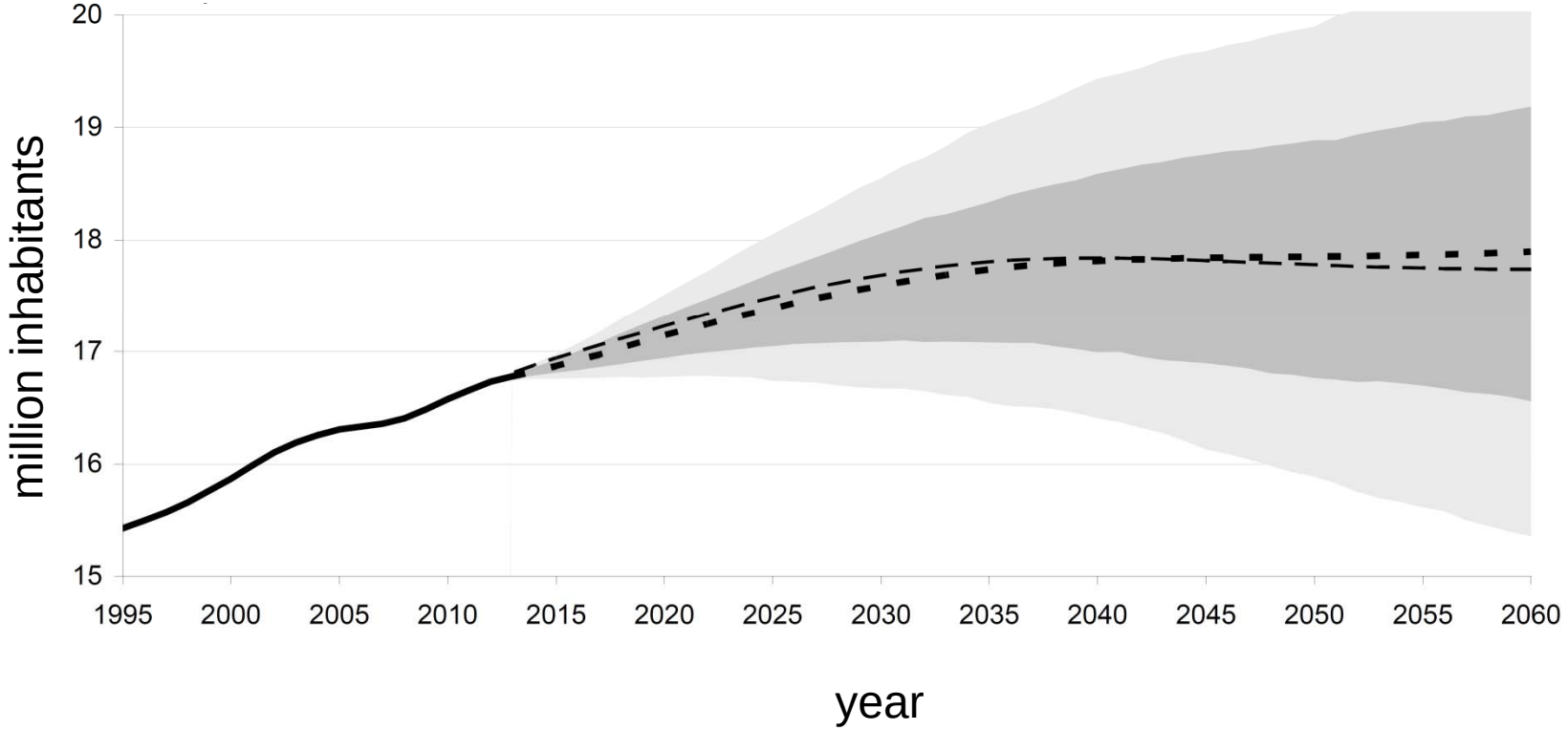
Impact – uncertainty analysis
of contextual developments



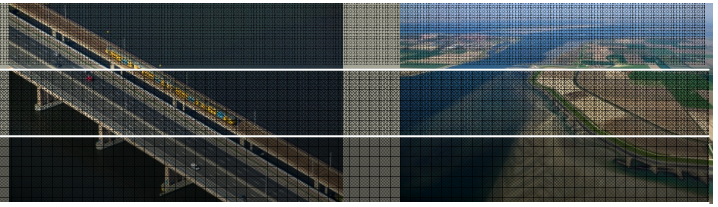
Demography NL

Population projections 2012-2060

in 2100: 12-24 million (UN)



Scenario basics



21st century, NL

		high	low
Population	M	24	12
Economy (GDP/cap)	%/y	+ 2	+ 1
Climate change	°C	+ 4	+ 2
Oil price	$/b	100 ?	200 ?

- Plausible range, no prediction, nor probability
- Future context, not policy
- Consistent, distinct, relevant

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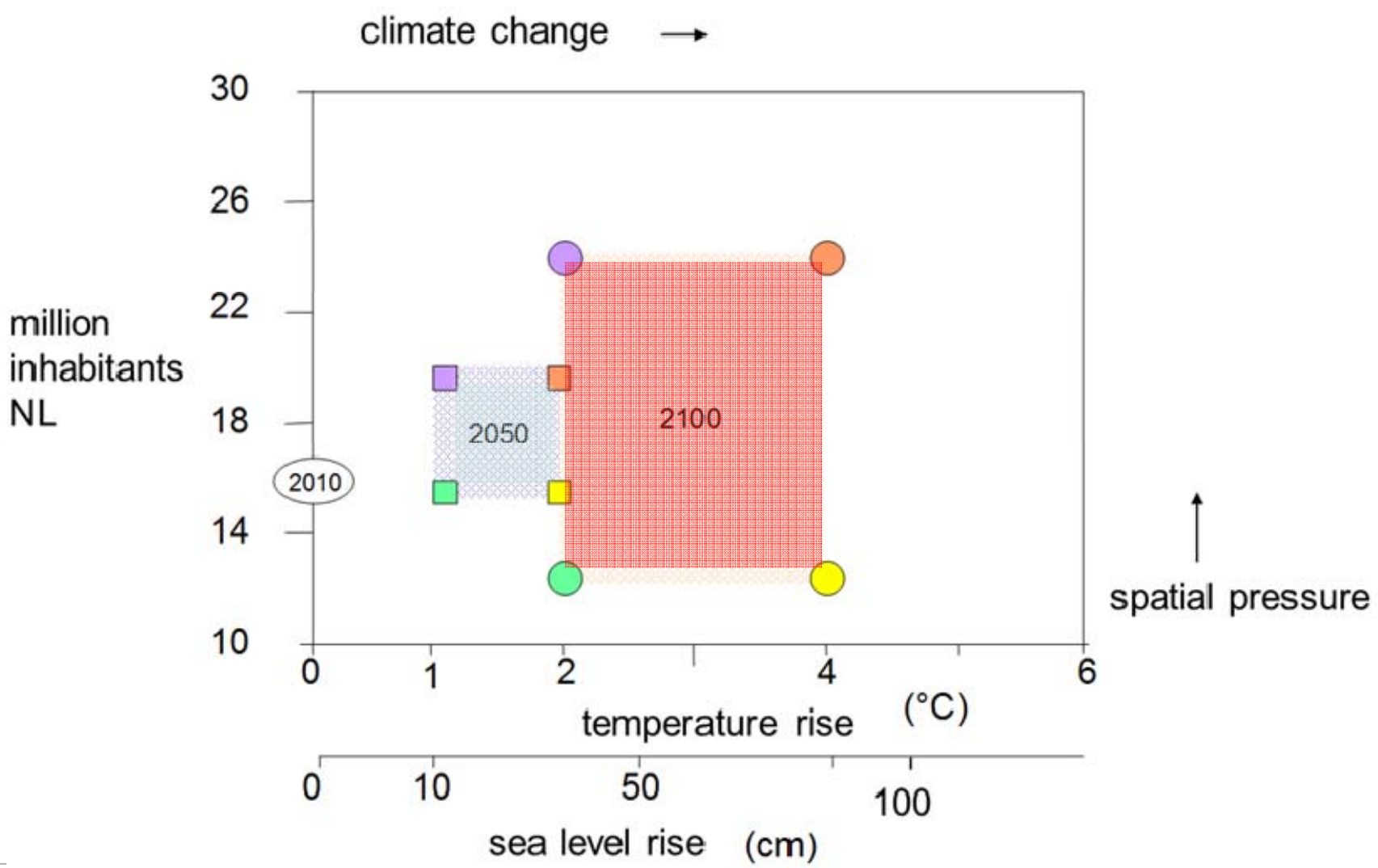
Climate change and socio-economic developments in 2050 and 2100



Comparison of socio-economic characteristics in two high growth scenarios

BUSY

- concentrated urbanization
- high efficiency in use of materials, energy, water, food
- bio-based, circular
- collectivism, participation

STEAM

- urban sprawl
- profitable exploitation of natural resources
- fossil
- individualism, market

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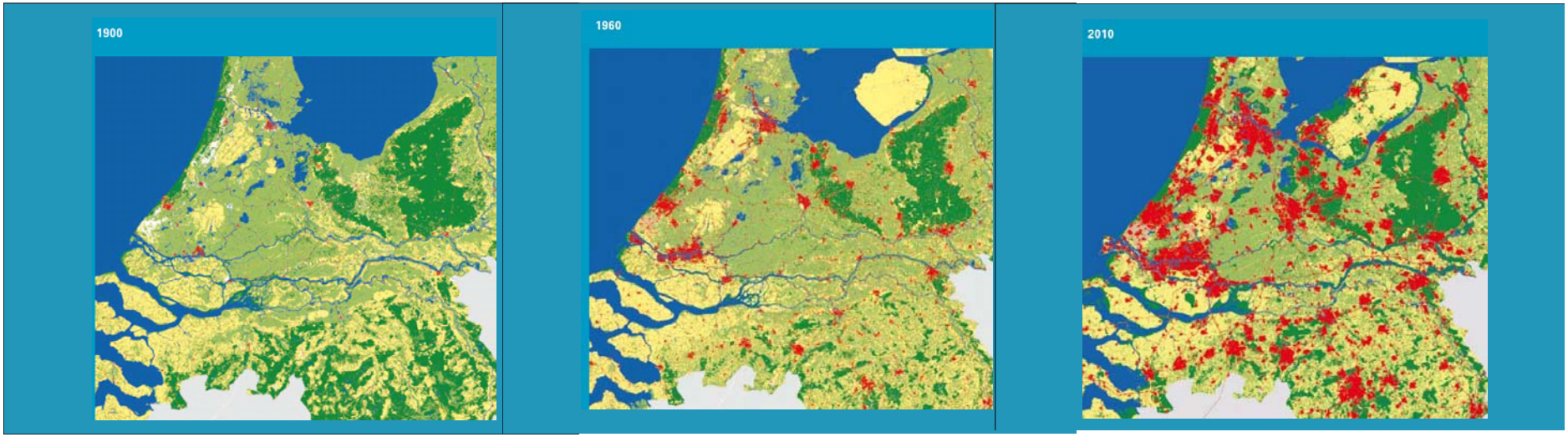
NL: spatial developments in the last century

1900 1960 2010



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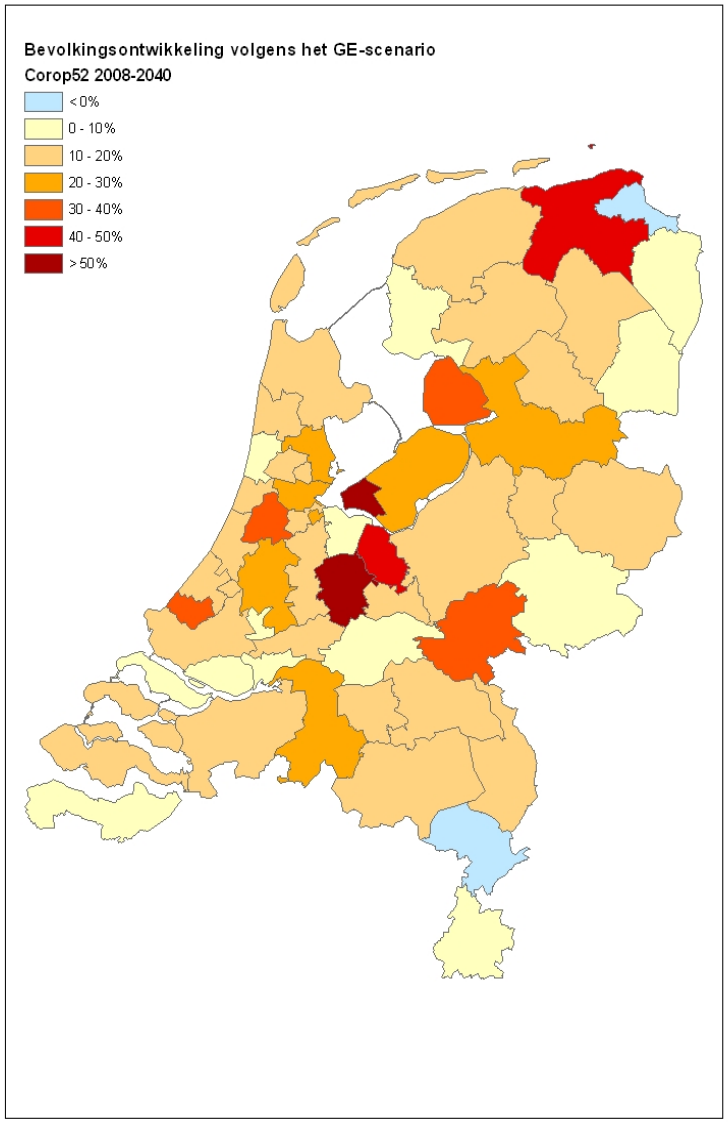
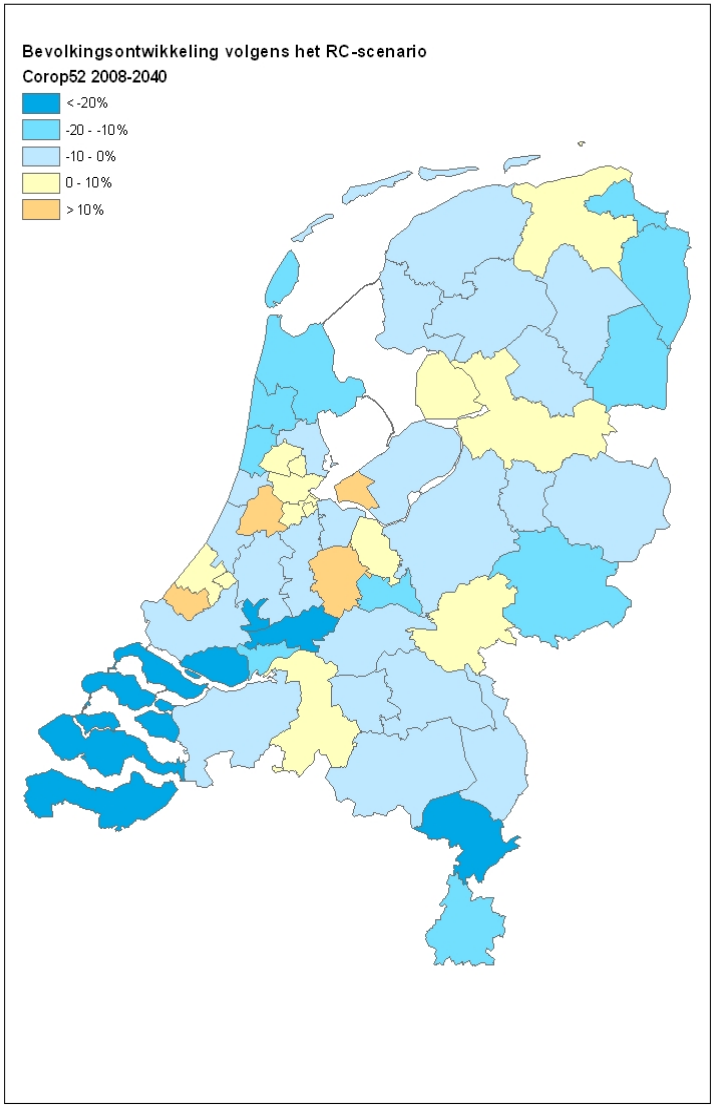
Regional population development 2008 - 2040

STEAM, BUSY

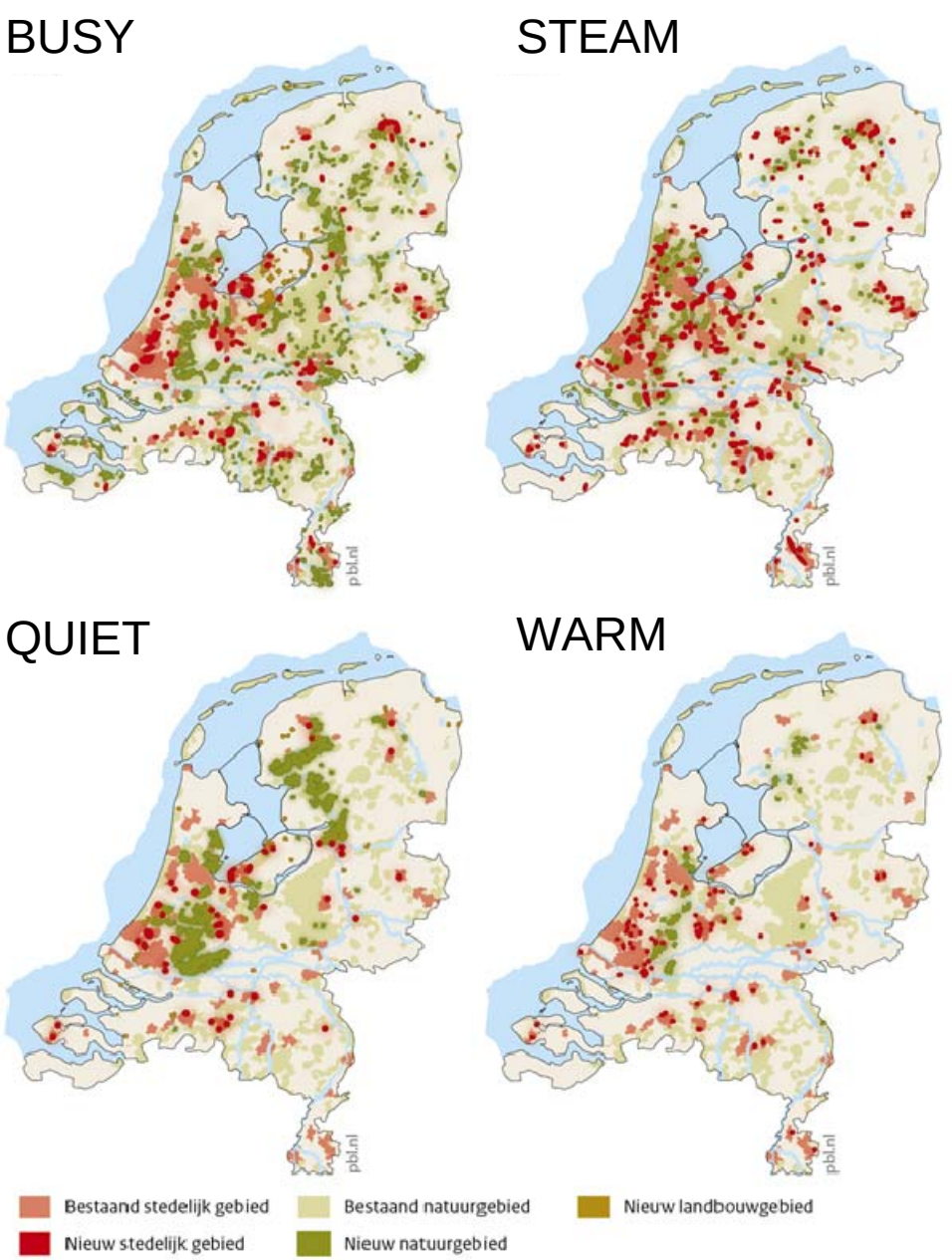


WARM, QUIET



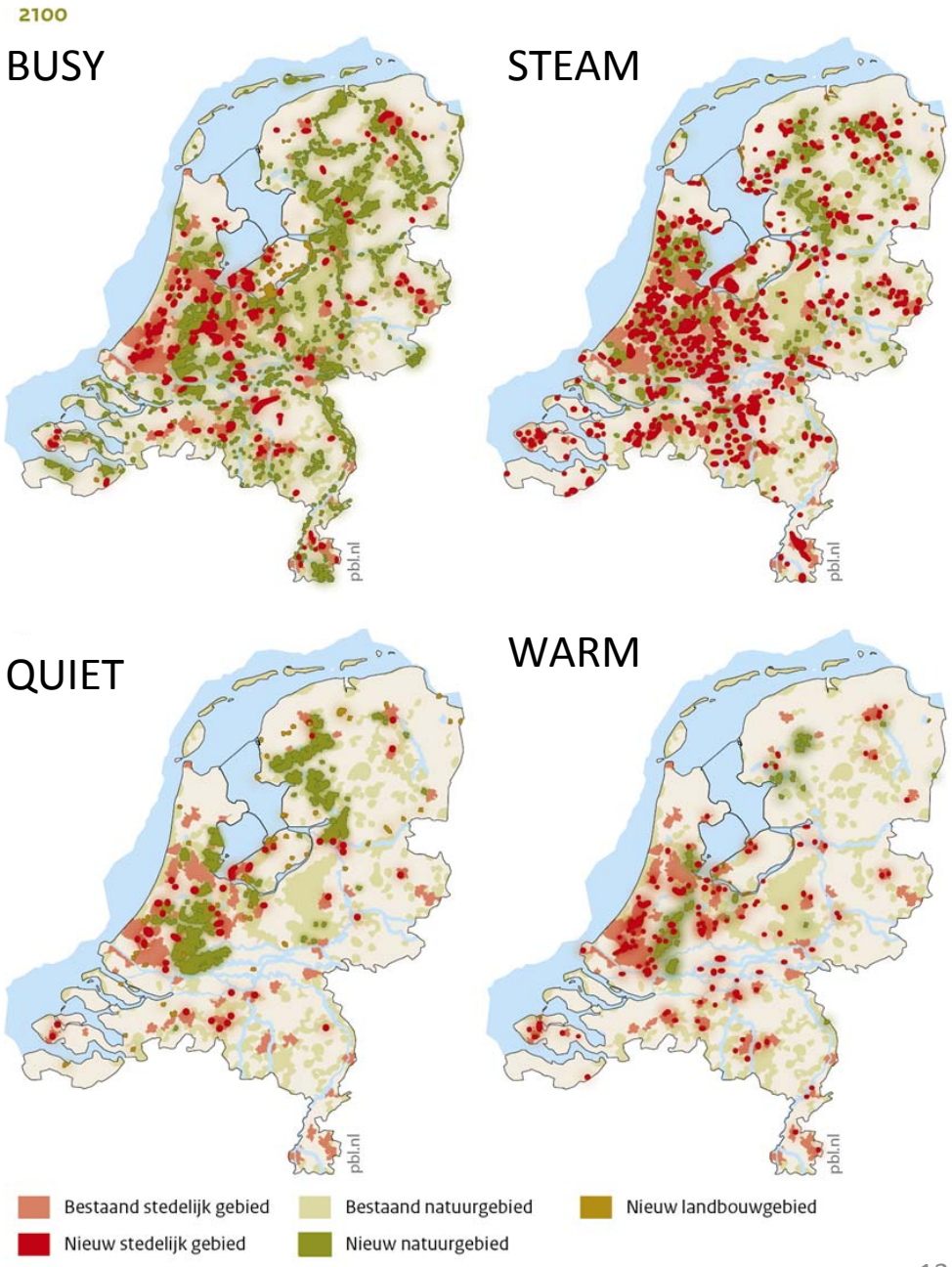
Changing land use in the four Delta Scenarios,

focus year 2050



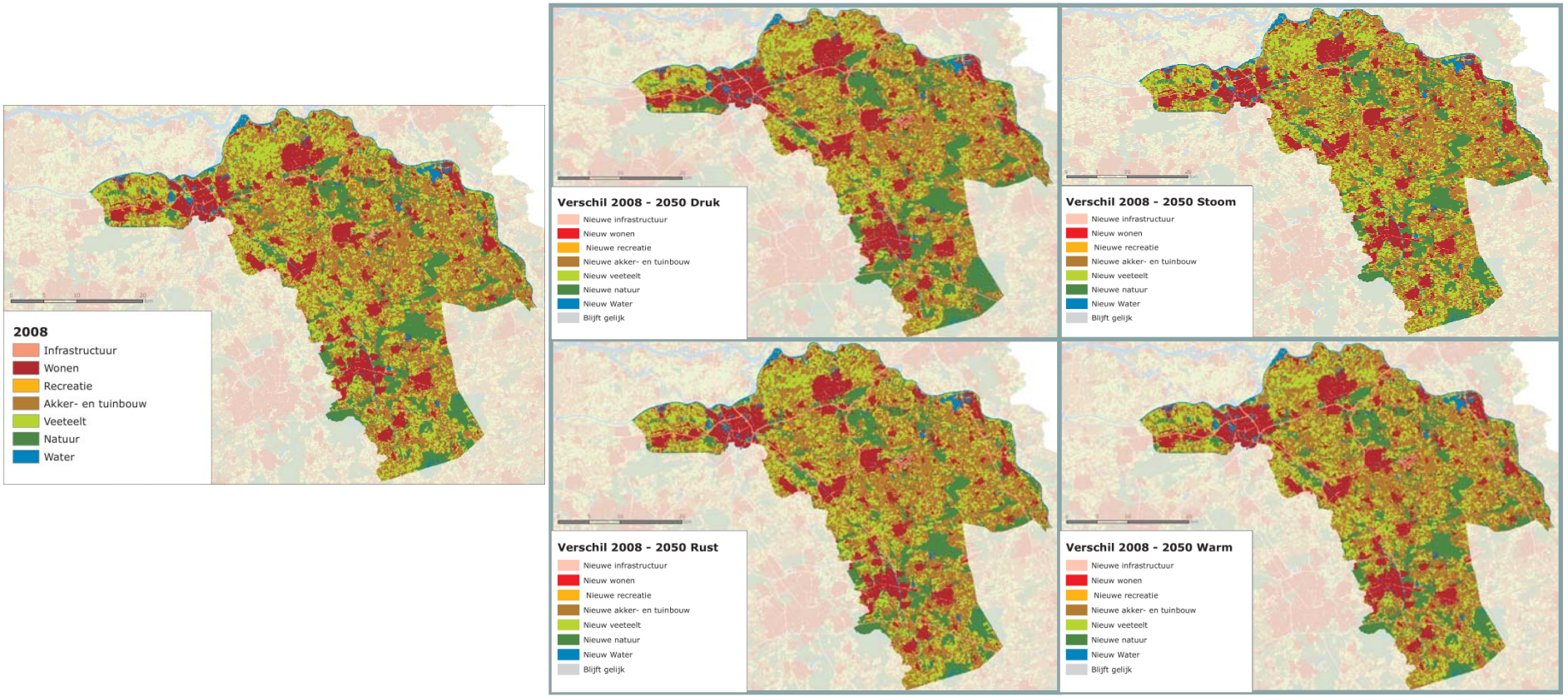
Changing land use in the four Delta Scenarios,

focus year 2100



Changing land use: details

Aa en Maas: N-Brabant



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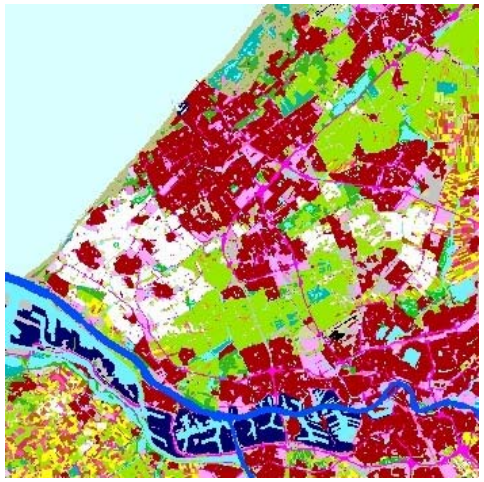
Changing land use: details Delfland 2050

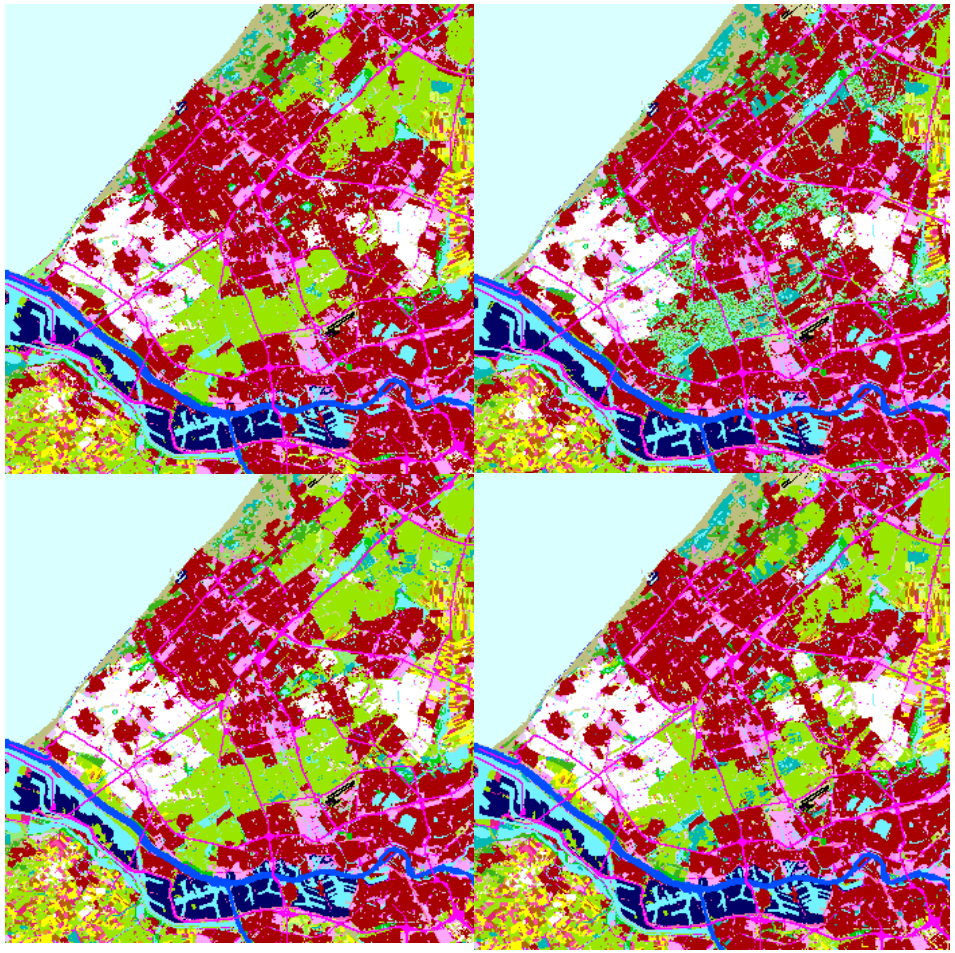
Rotterdam-The Hague

2008



- spoorlijnen
- wegen
- vliegvelden
- woongebied
- bedrijventerrein
- voorzieningen
- zeehavens
- bouwterrein
- semi verhard
- recreatie -dagrecreatie ed
- recreatie - verblijf
- gras in secundair bebouwd gebied
- Glastuinbouw
- mais
- aardappelen
- bieten
- granen
- Opengrond Groenten
- bloembollen
- agrarisch gras
- boomgaarden
- boomteelt
- natuur gras
- nat_loofbos
- nat_naaldbos_licht
- nat_naaldbos_donker
- nat_nat
- nat_droog
- groot zoetwater bestaand
- zoutwater bestaand
- rivieren bestaand
- overigwater bestaand
- boezemwater bestaand
- buitenland

BUSY 2050 STEAM



QUIET WARM

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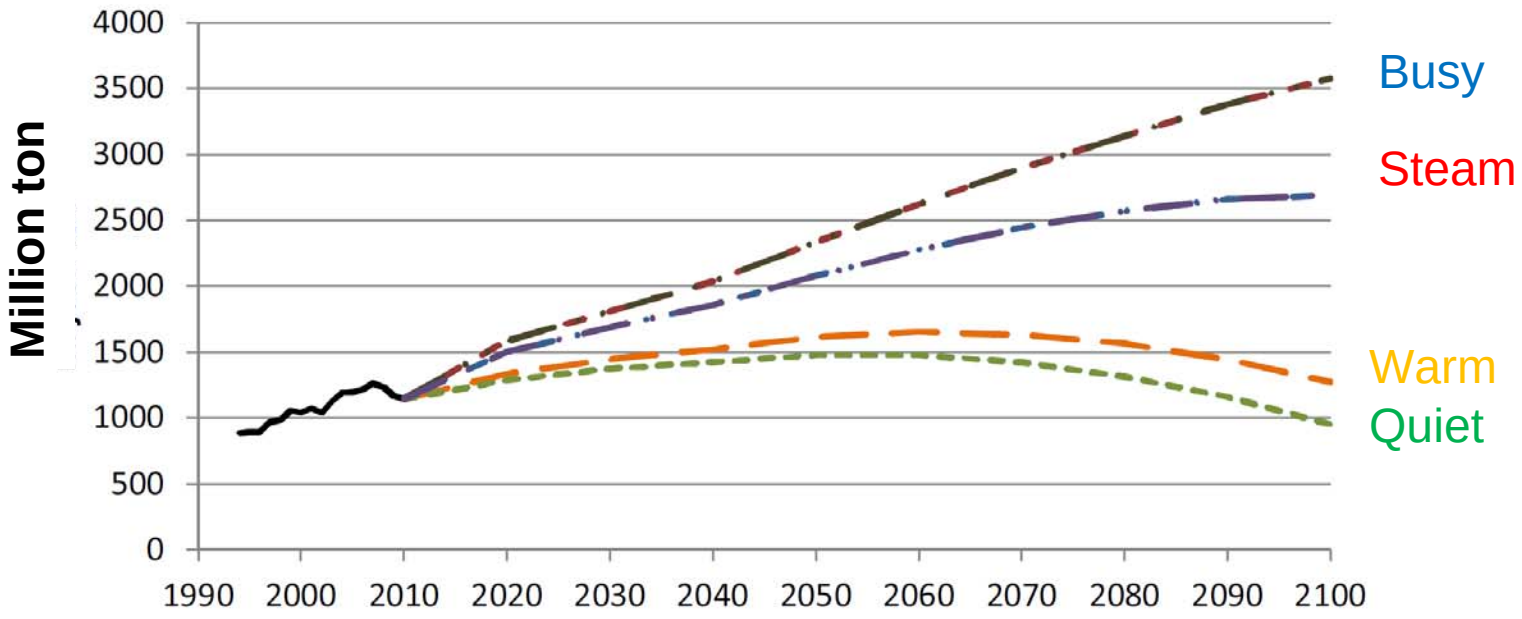
Inland transport, total volume, 2000-2100



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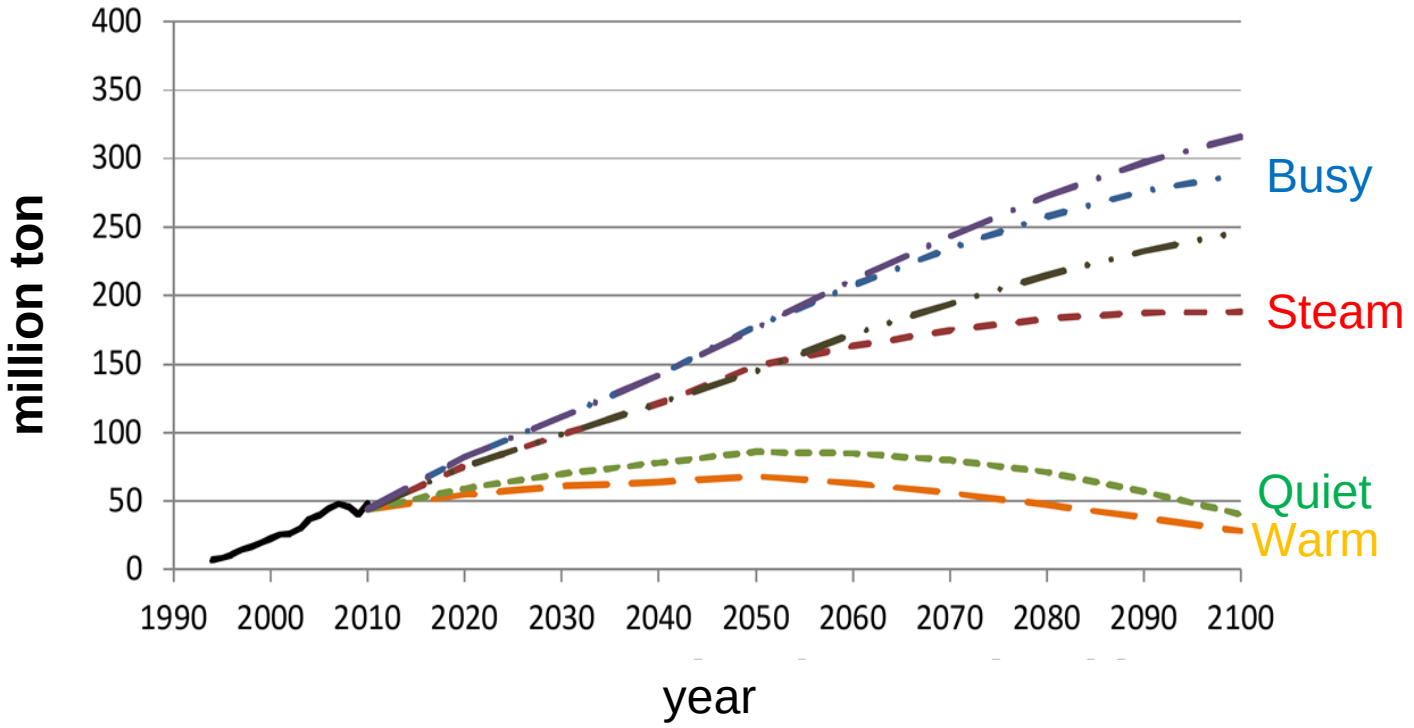
Inland container shipping, 2000-2100 NL



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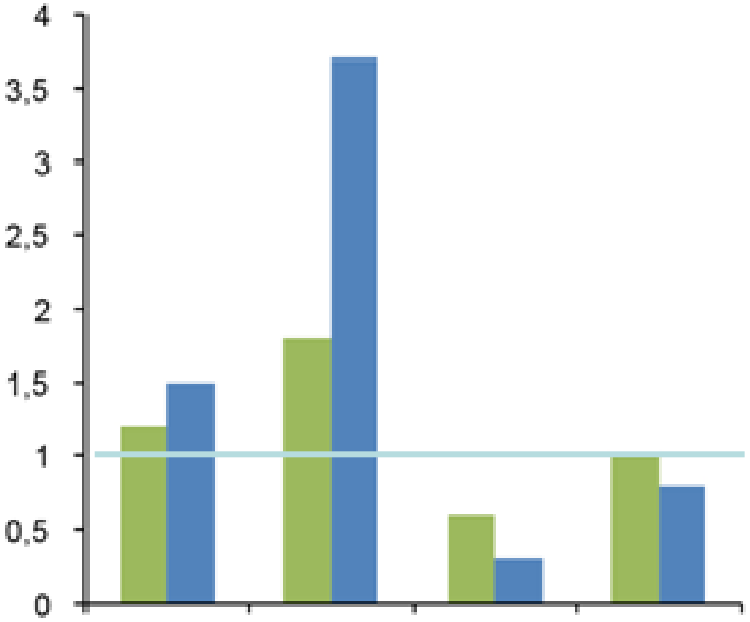
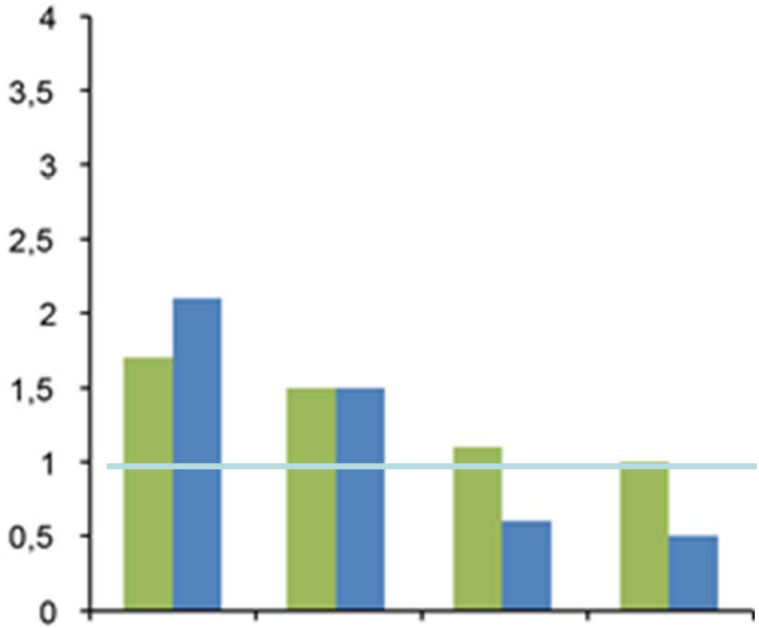
Development of economic sectors in NL

2008 = 1



energy: cooling water 2050

2100



inland shipping 2050

2100

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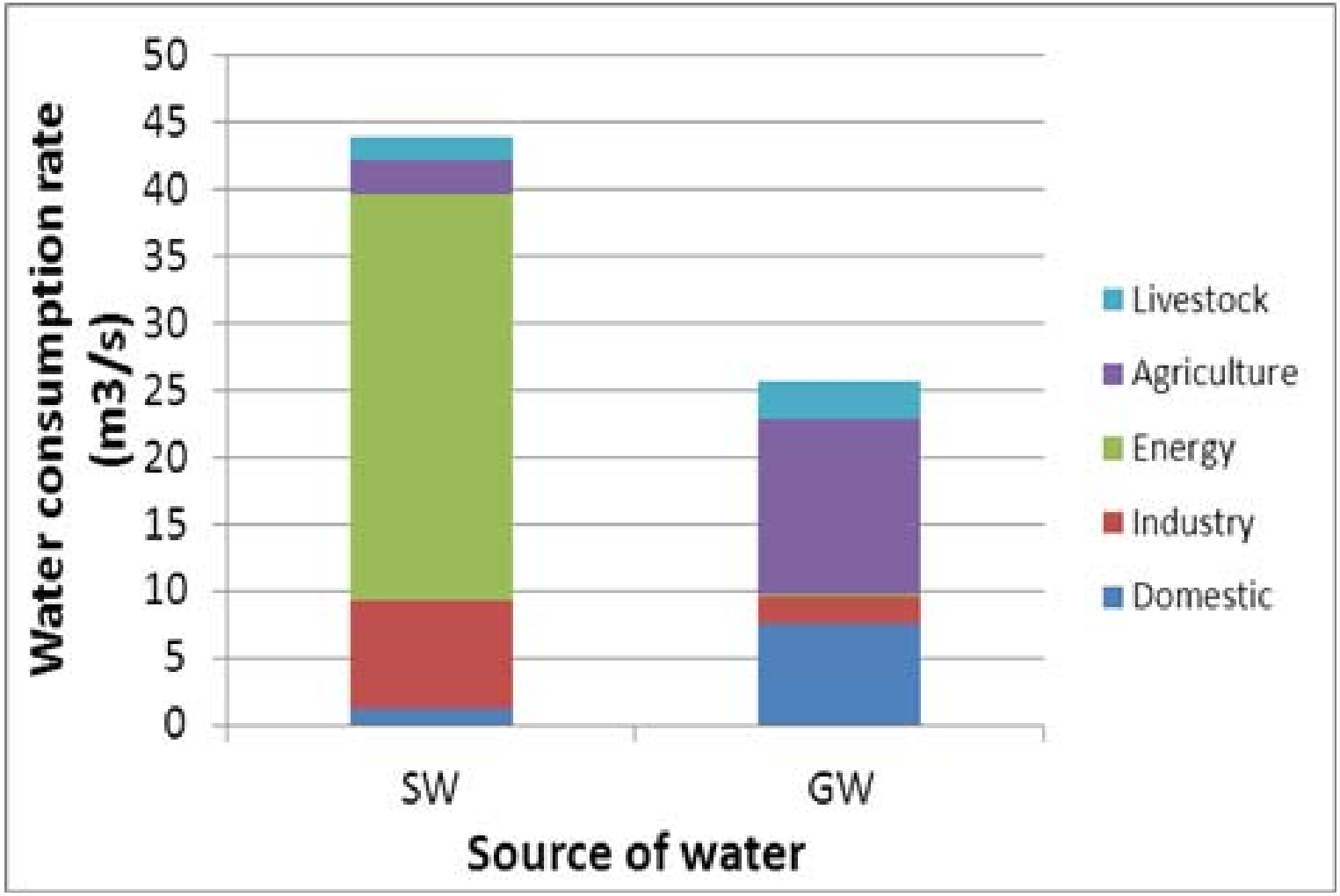
Water consumption in Rhine river basin



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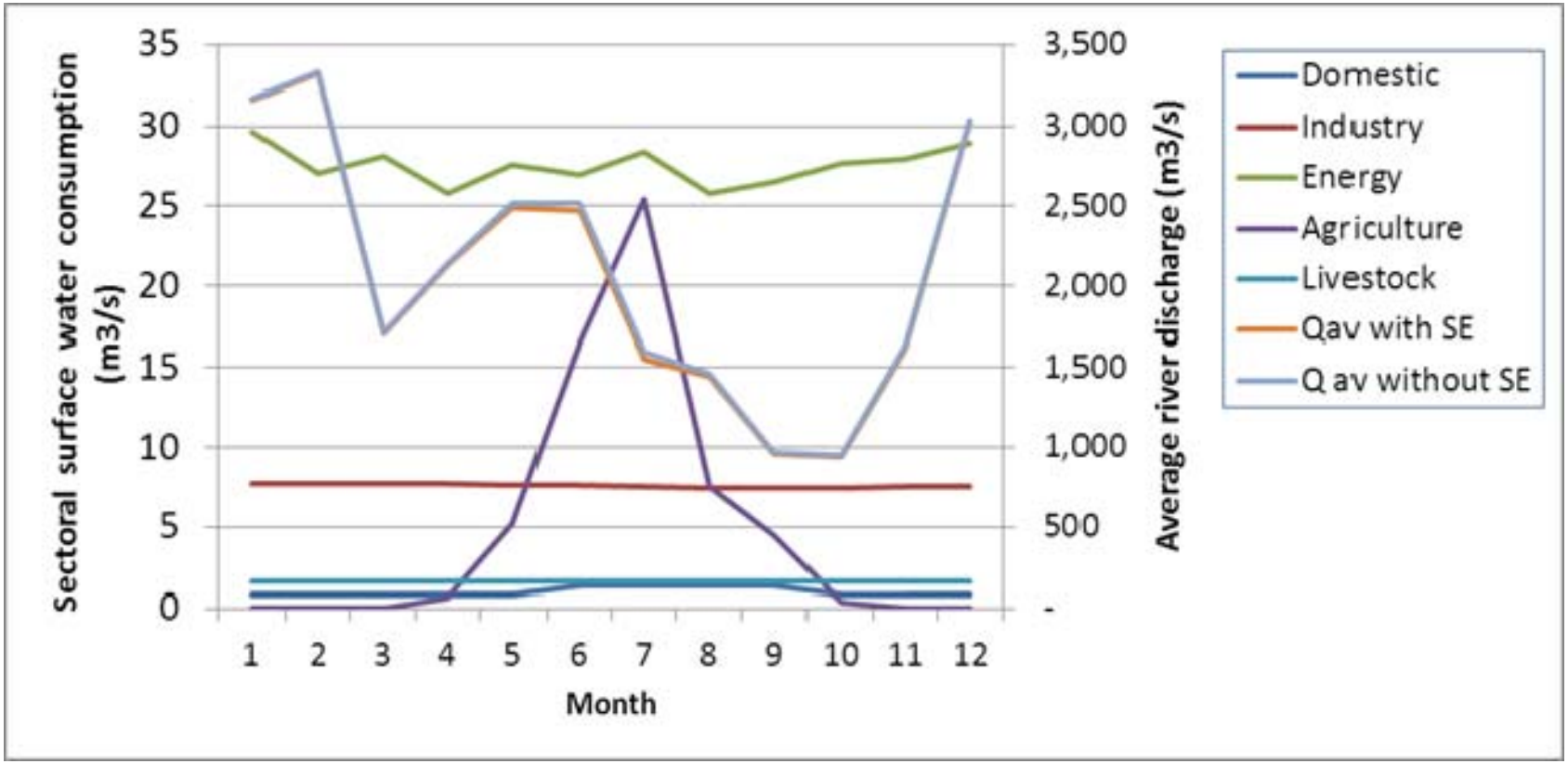
Seasonal variation in Rhine water consumption



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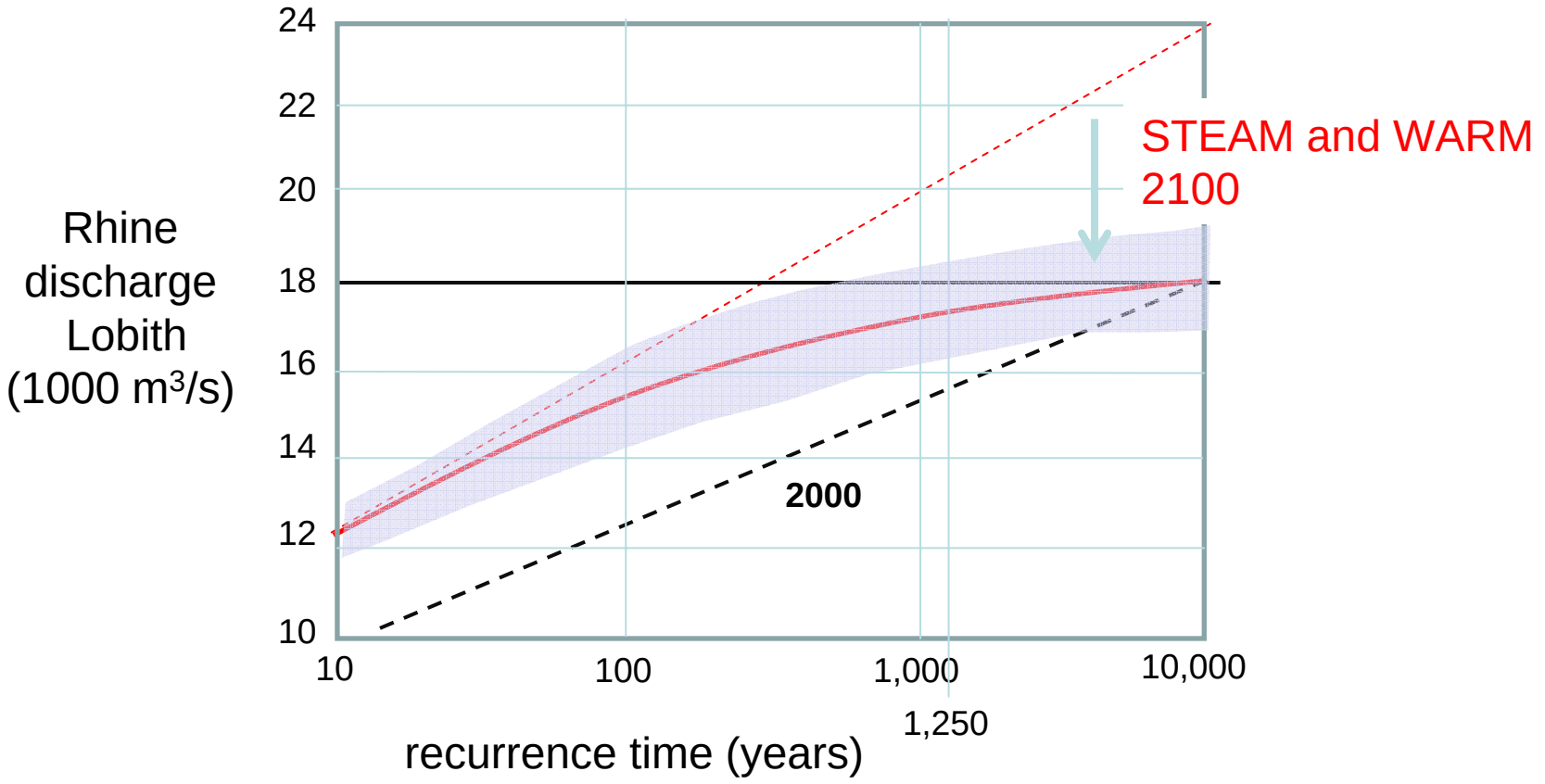
Extreme Rhine discharges leveled off by flooding in Germany?



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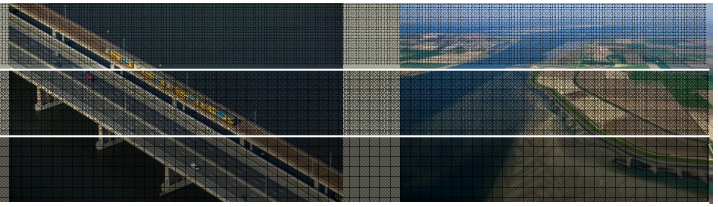
Extreme river discharges



2100, effects of climate change on Rhine river discharge extremes

	2000	BUSY, QUIET	STEAM, WARM
Climate change	0	+ 2 ^{o}C	+ 4 ^{o}C
Dry periods recurrence time (100 days, Q < 1,000 m^3/s)	90 y	150 y	4 y
Extreme high discharge recurrence time (> 15,000 m^3/s)	1250 y	400 y	100 y

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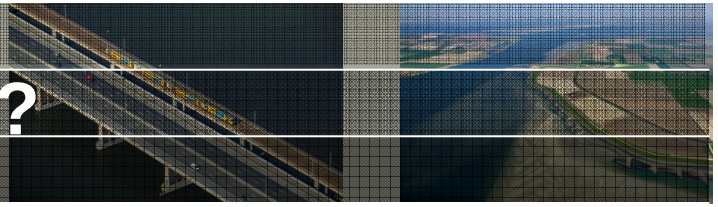
Scenarios: to be continued …?



- Integration of climate change and socio-economic scenarios: from CO_2 to land use, hydrology and governance
- Consistent, challenging, quantitative
  detailed, but not accurate
- Quantifying uncertainty
- **Need: W-EU, integrated river basin scenarios**

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Key figures

Key figures by scenario		BUSY		STEAM		QUIET		WARM	
Focus year →	2000	2050	2100	2050	2100	2050	2100	2050	2100
Climate change (°C)		+ 1	+ 2	+ 2	+ 4	+ 1	+ 2	+ 2	+ 4
Sea-level rise (cm)		+ 15	+ 35	+ 35	+ 85	+ 15	+ 35	+ 35	+ 85
Average discharge of Rhine in February (m^3/s)	2,900	3,100	3,200	3,400	4,000	3,100	3,200	3,400	4,000
Average discharge of Rhine in September (m^3/s)	1,800	2,000	2,100	1,300	900	2,000	2,100	1,300	900
Average discharge of Meuse in February (m^3/s)	480	500	520	530	590	500	520	530	590
Average discharge of Meuse in September (m^3/s)	89	92	94	48	30	92	94	48	30
Extremely high Rhine discharge, 1/100 years (m^3/s)	12,500	13,000	14,000	14,000	15,000	13,000	14,000	14,000	15,000
Extremely high discharge Meuse 1/100 years (m^3/s)	2,900	3,000	3,200	3,200	3,600	3,000	3,200	3,200	3,600
Recurrence time Rhine discharge>15,000 m^3/s (year)	1,250	1,000	400	400	100	1,000	400	400	100
Recurrence time Meuse discharge>3,600 m^3/s (year)	1,250	1,000	400	400	100	1,000	400	400	100
Extremely low discharge of Rhine 1/10 years (m^3/s)	630	650	670	520	420	650	670	520	420
Extremely low discharge Meuse 1/10 years (m^3/s)	18	18	18	10	6	18	18	10	6
Dry periods in Rhine (100 successive days on which discharge is less than 1000 m^3/s): recurrence time (years)	90	120	150	20	4	120	150	20	4
Dry periods in Meuse (50 successive days on which discharge is less than 25 m^3/s): recurrence time (years)	300	300	300	20	4	300	300	20	4
Average precipitation winter		+ 4%	+ 7%	+ 14%	+ 28%	+ 4%	+ 7%	+ 14%	+ 28%
Average precipitation summer coast		+ 3%	+ 6%	- 12%	- 26%	+ 3%	+ 6%	- 12%	- 26%
inland		+ 3%	+ 6%	- 19%	- 38%	+ 3%	+ 6%	- 19%	- 38%
Extreme summer precipitation (daily total 1/10 year) coast		+ 13%	+ 27%	+ 18%	+ 33%	+ 13%	+ 27%	+ 18%	+ 33%
inland		+ 13%	+ 27%	+ 5%	+ 8%	+ 13%	+ 27%	+ 5%	+ 8%
Number of inhabitants in the Netherlands (million)	16	20	25	20	25	15	12	15	12
Economic growth in the Netherlands (GDP, %/year)		2.5	2.5	2.5	2.5	1.0	0.5	1.0	0.5
Urbanisation (% surface area)	20	23	25	25	29	21	21	21	21
Agriculture (% surface area)	59	51	45	51	40	56	55	56	55
Nature and recreation (% surface area)	18	22	26	20	25	20	20	19	20