The Impact of Large-scale Renewable Integration on Europe's Energy Corridors (2030 – 2050)

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Outline

1. Introduction & focus
2. Approach
3. Results
4. Conclusions
5. Recommendations

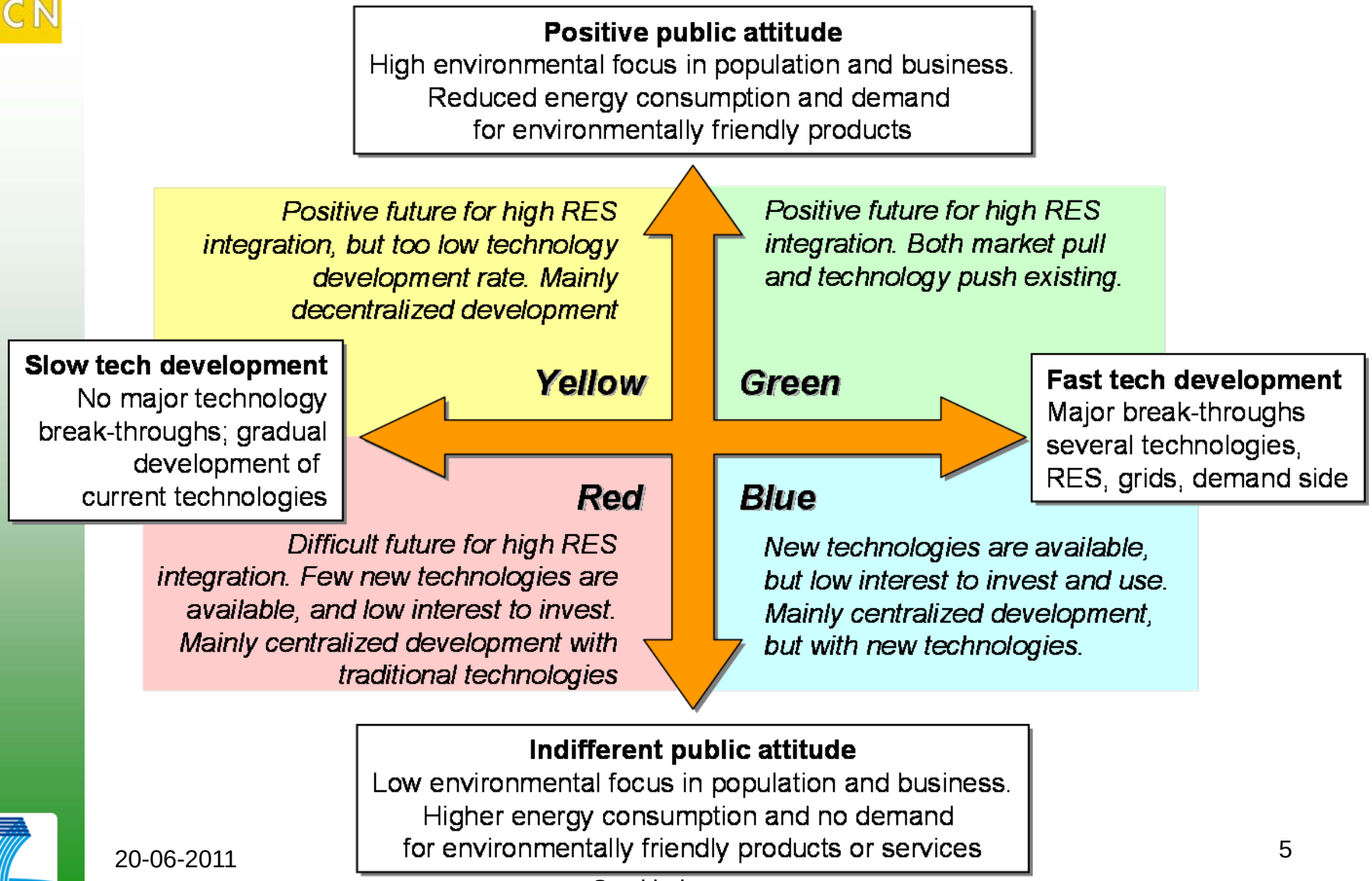
1. Introduction & focus

- Increasing deployment of low carbon energy producing technologies
- Affects markets and infrastructure requirements
- Integral assessment of electricity and gas markets
- SUSPLAN project
  - Development of regional and pan-European guidelines for more efficient integration of renewable energy into future infrastructures
- Focus presentation:
  - What are infrastructure developments in different futures?
  - What is the impact of increasing RES on the energy system?

2. Approach

- Model-based
  - Simulation model representing European **electricity** market and transmission infrastructure (MTSIM model RSE)
  - Simulation model representing European **gas** market and gas infrastructure (transmission, LNG, storage) (Gastale model ECN)
  - Economic optimization
- Interactive analysis
  - Iterations between the two models, both allowing for optimal usage of existing capacity and expansion of capacity
- Long-term perspective
  - **Starting point 2030**, analysis for 2030 - 2050
- Storyline-based
  - *See next slide*

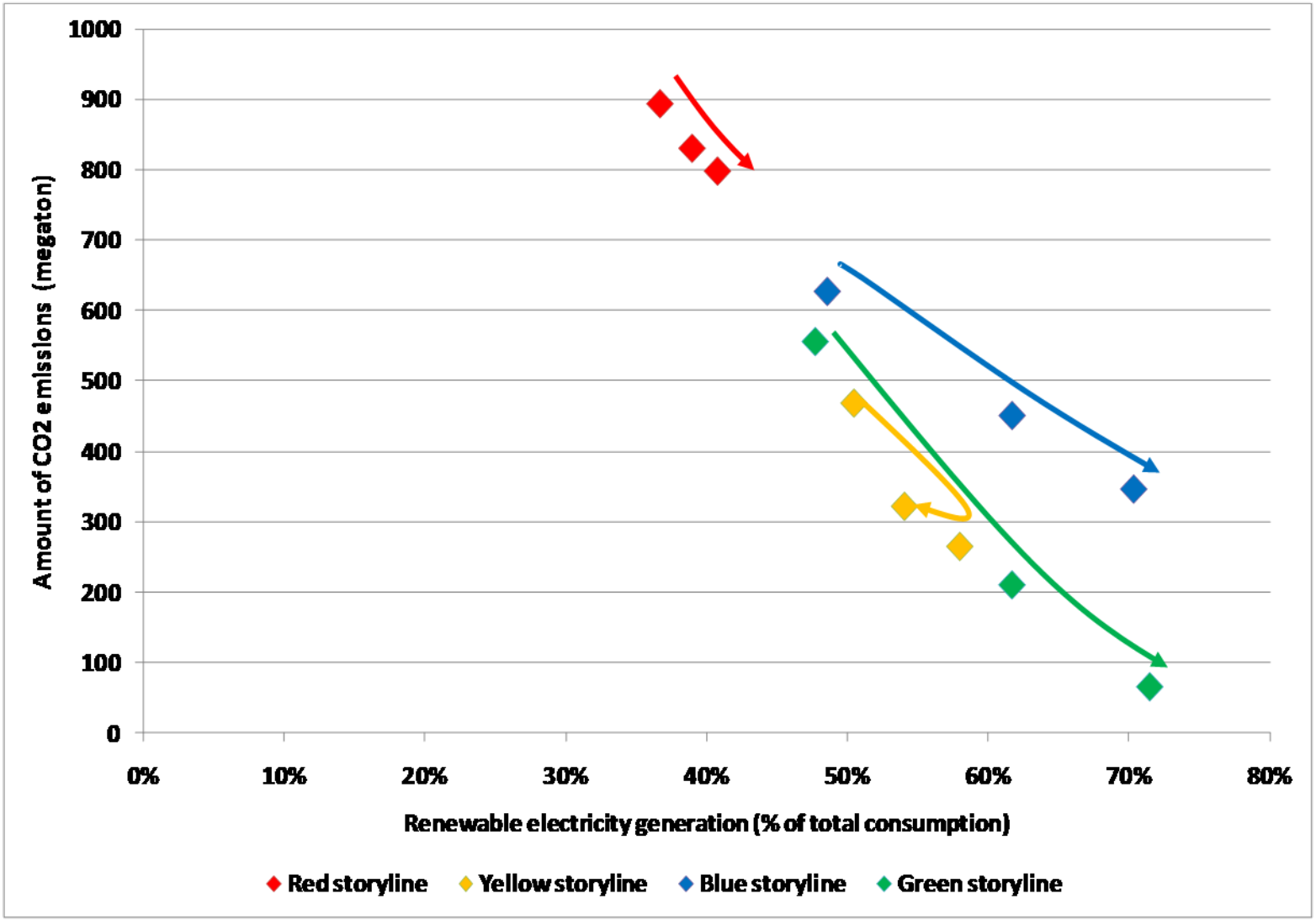
2. Approach
Introduction to SUSPLAN Storylines



3. Results

Reduction in CO_2 emissions across storylines

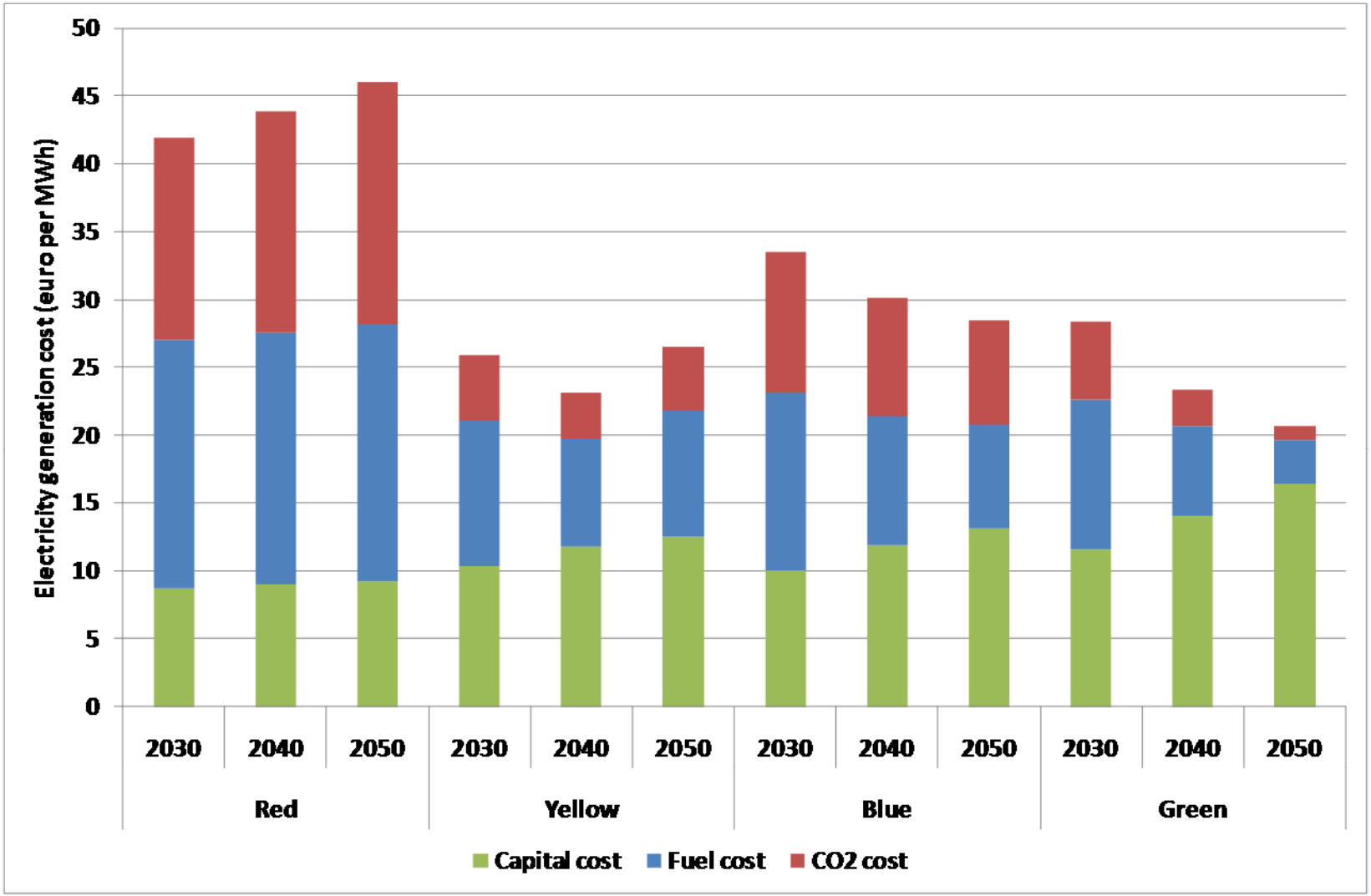
3. Results



Electricity generation cost

Contrast between capital & operational cost impact

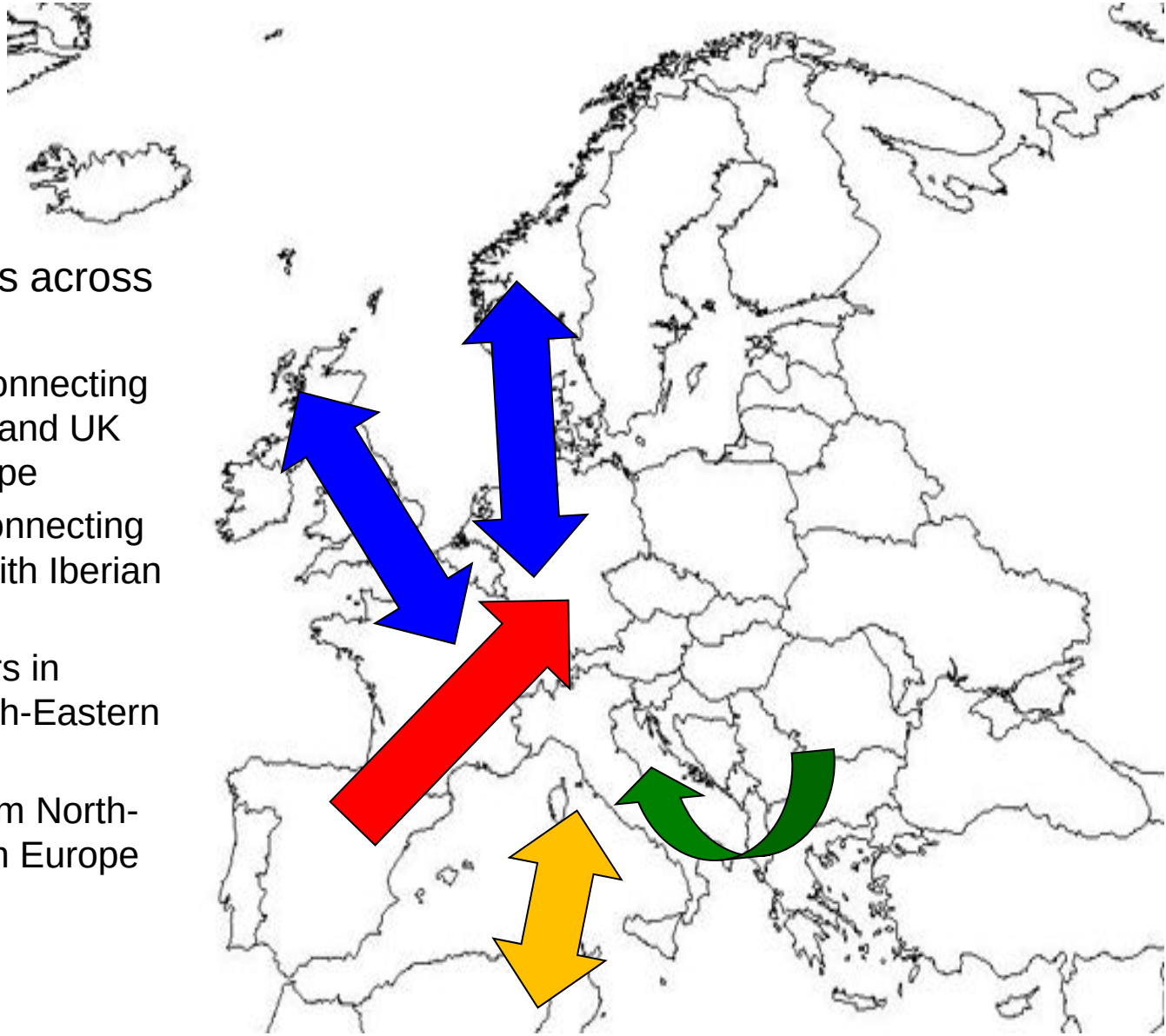
3. Results



Electricity corridors

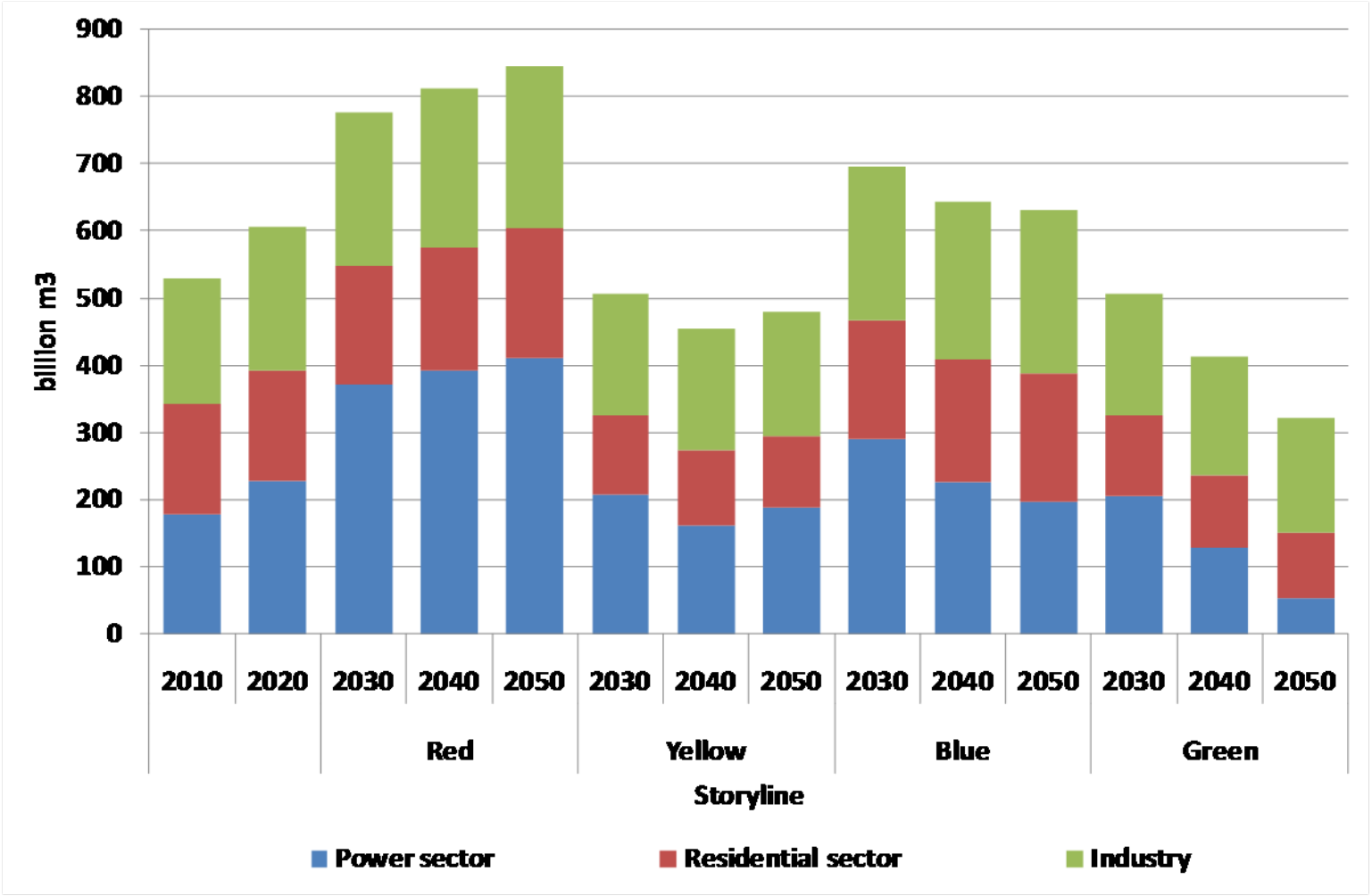
Robust corridors across storylines:

- DC corridors connecting Northern Europe and UK with Central Europe
- AC corridors connecting Central Europe with Iberian Peninsula
- DC/AC corridors in Eastern and South-Eastern Europe
- DC corridor from North-Africa to Southern Europe



Total gas consumption

Power sector is main driver across storylines



3. Results

Change in gas demand 2010 - 2050

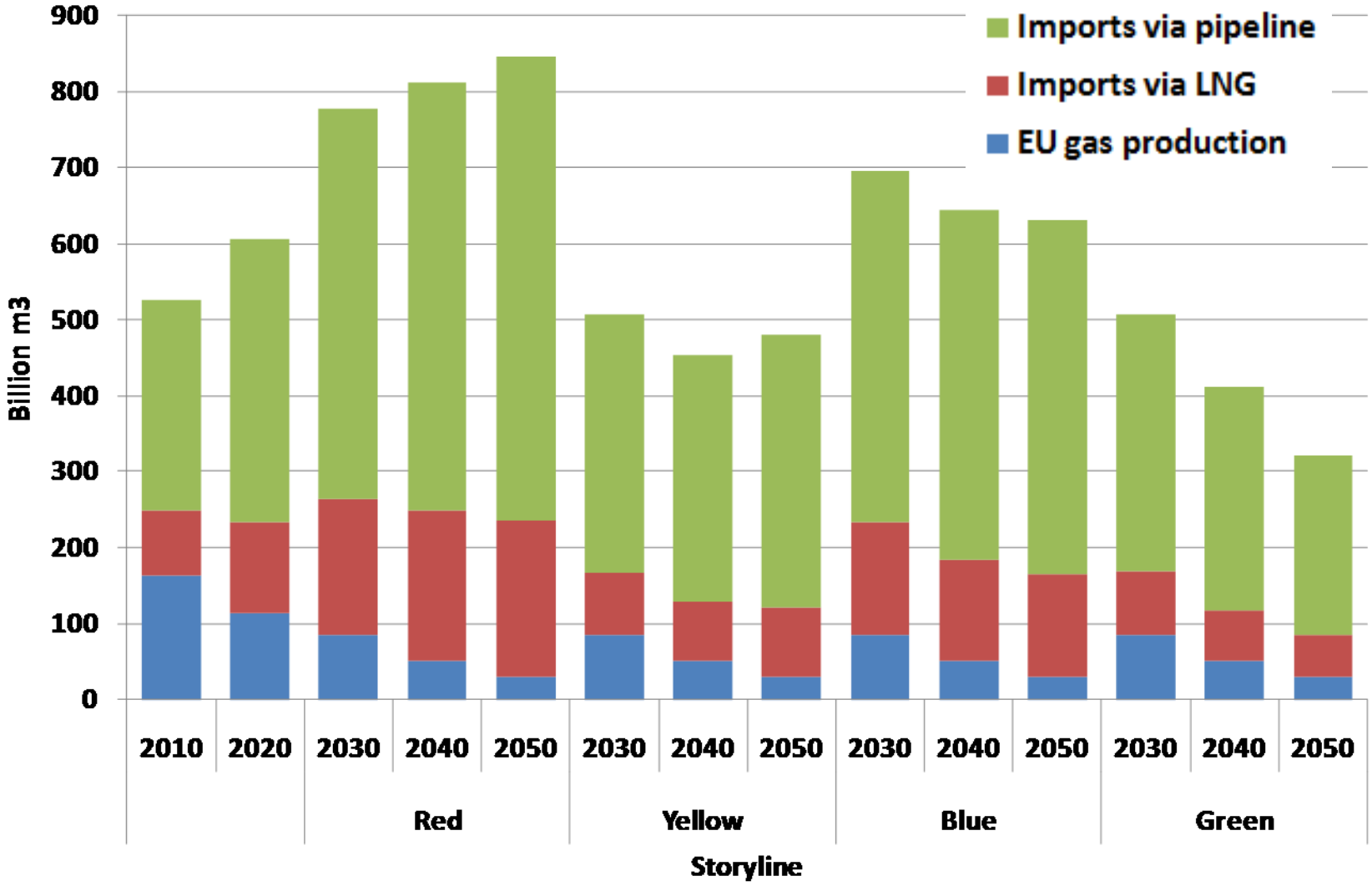
(billion m3)

	-69 to -50
	-49 to -30
	-29 to -10
	-9 to 10
	11 to 30
	31 to 50
	51 to 70
	71 to 90

3. Results

SEVENTH FRAMEWORK PROGRAMME

EU gas supply sources



3. Results

Main observations on gas corridors and hubs

- Turkey – Southeastern Europe strong corridor in all storylines
  - Including downstream expansions in region
- Depletion of gas reserves in the UK and the Netherlands
  - Limited infra expansion in Northwestern Europe
- Most important storyline differences occur in South and Southwestern Europe
  - Pipeline imports North Africa – Spain / Italy
  - LNG imports in Italy & Spain
  - Italy as gas hub in high demand storylines, triggering pipeline expansion downstream (region)

Summary across storylines

Yellow

		2030	2040	2050
Electricity consumption	PWh	4.2	4.2	4.2
Renewable electricity generation	PWh	2.1	2.4	2.3
	%	50%	58%	54%
Gas consumption	Billion m3	507	455	480
Gas imports	Billion m3	422	403	449
Electricity infrastructure expansion	GW		55	22
Gas pipeline expansion	Billion m3	142	35	41
CO2 emissions electricity sector	Megaton	468	264	321

Green

		2030	2040	2050
Electricity consumption	PWh	4.2	4.2	4.2
Renewable electricity generation	PWh	2.0	2.6	3.0
	%	48%	62%	71%
Gas consumption	Billion m3	507	412	321
Gas imports	Billion m3	422	361	291
Electricity infrastructure expansion	GW		72	65
Gas pipeline expansion	Billion m3	143	28	34
CO2 emissions electricity sector	Megaton	556	210	66

Red

		2030	2040	2050
Electricity consumption	PWh	4.8	5.1	5.3
Renewable electricity generation	PWh	1.8	2.0	2.2
	%	37%	39%	41%
Gas consumption	Billion m3	777	812	846
Gas imports	Billion m3	692	761	815
Electricity infrastructure expansion	GW		36	20
Gas pipeline expansion	Billion m3	250	93	125
CO2 emissions electricity sector	Megaton	893	830	798

Blue

		2030	2040	2050
Electricity consumption	PWh	4.9	5.1	5.4
Renewable electricity generation	PWh	2.4	3.2	3.8
	%	49%	62%	70%
Gas consumption	Billion m3	696	644	631
Gas imports	Billion m3	611	593	601
Electricity infrastructure expansion	GW		56	56
Gas pipeline expansion	Billion m3	271	50	48
CO2 emissions electricity sector	Megaton	627	451	347

Summary across storylines
Electricity vs. gas infrastructure impact

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Summary across storylines
Electricity consumption - infra expansion

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4. Conclusions

- Increasing RES has large consequences for investment requirements in trans-national electricity infrastructure (AC and DC)
  - If comparative advantages in RES potential in Europe are used
  - Results in particular electricity corridors
- Power sector main driver for gas market developments
  - Differences across Europe → corridors and LNG hubs
- Increase in RES has positive impact on operational costs, but negative impact on capital costs, net impact is likely to be positive with increasing RES share.
- Higher electricity infrastructure requirements may partly be compensated by lower gas infrastructure requirements

5. Recommendations

- Further support for focused infrastructure policy, with particular attention for some corridors (i.e. EU infrastructure package)
- Need for adequate policy signals regarding long-term CO2 price, since it is a major uncertainty in shaping of electricity generation mix
- Electricity infrastructure affects gas infrastructure (and vice versa), so energy policy should not focus on one sector in isolation
  - What is the future role of gas in the EU energy mix?