

Schleswig-Holstein

Energie 2020

Grünbuch: Windstrom > 100%

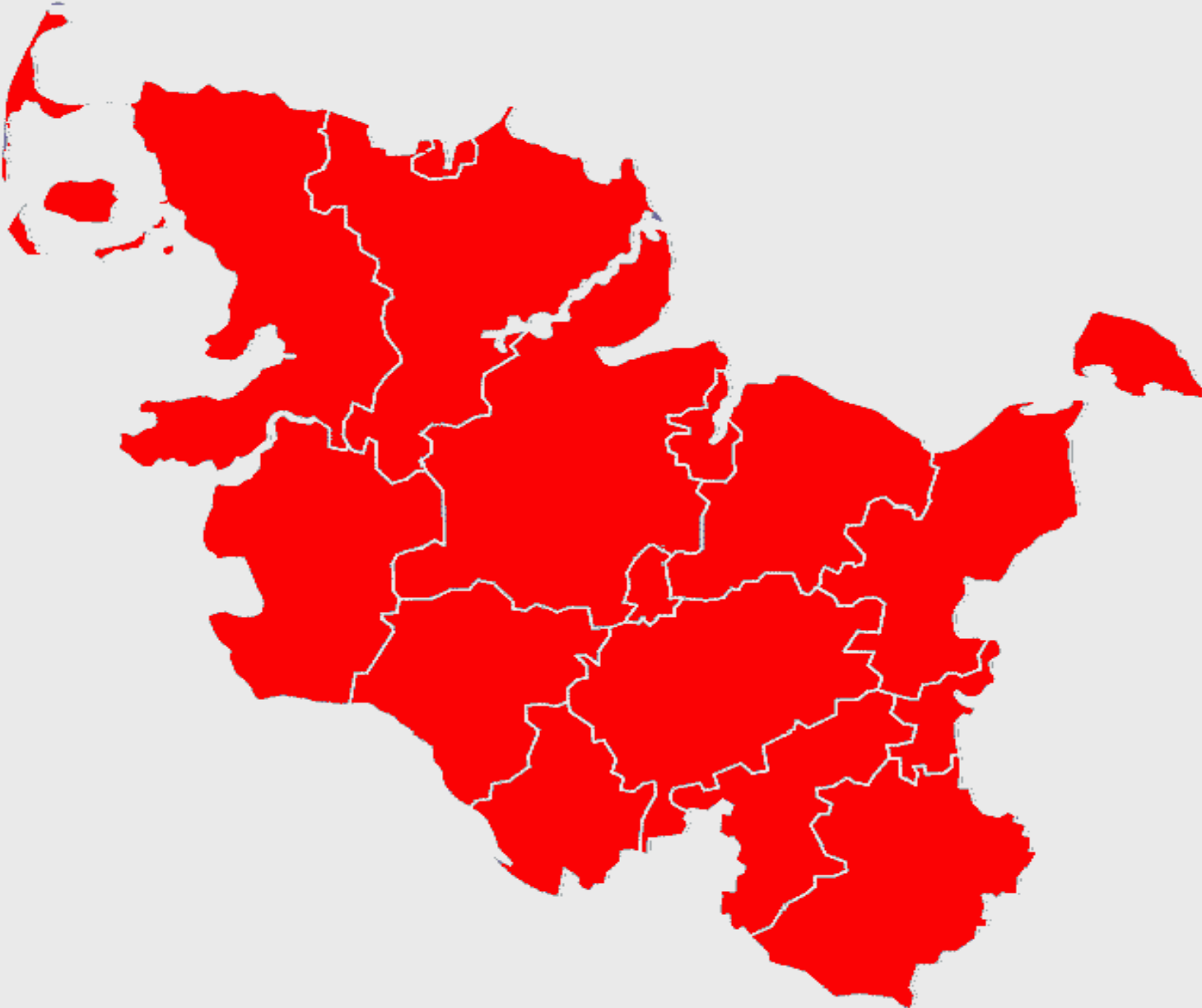
Gustav W. Sauer, Kiel

EnInnov 2010

Technische Universität Graz (TUG)

Graz, 10. - 12.02.2010

Schleswig-Holstein -- w³?



Fläche	15.799 Km ²
Einwohnerzahl	≈ 2,8 Millionen
Primärenergiebedarf	≈ 16,7 Mt SKE p.a. (498)
Stromnachfrage	13,5 TWh p.a.

2006: Stromerzeugung aus 37 TWh

Kohle	4,2
Öl	< 0,1
Gas	0,3
Kernenergie	28,0

Wind	2008: 5,3 : ≈ 40 % ↑↑
sonstige	0,3



Eignungsgebiete 2008 belegt : 120 Km² ≈ 0,8 %

technisch-ökonomisch nutzbar bis 2020

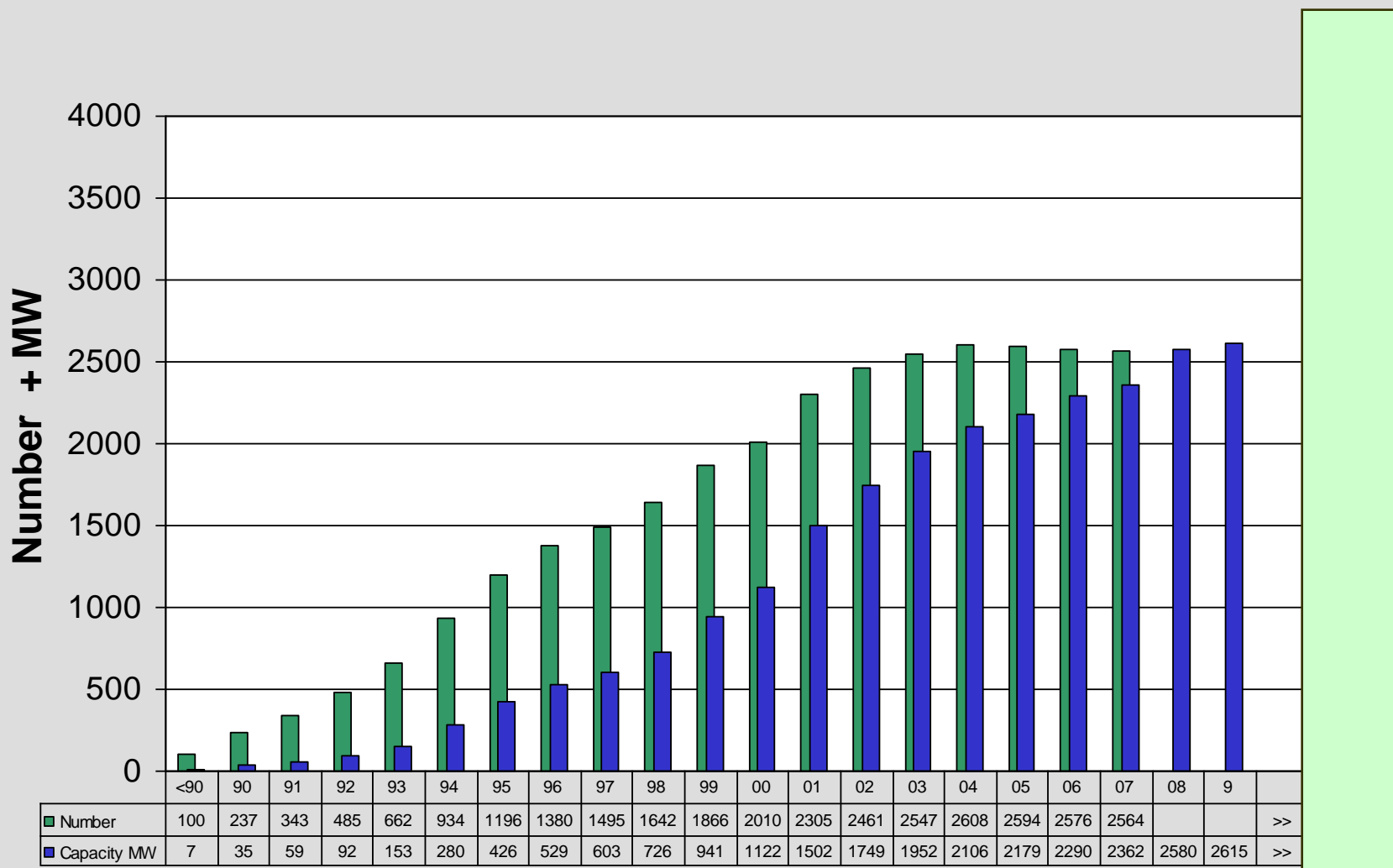
Schätzung für 2020 aus

2004: 4.000 MW (≤ 100 m Höhe)

Dez 2009: 4.800 MW (≤ 100 m Höhe, 1 %)

LRg 2010: 6.500 MW (> 100 m Höhe, ≈ 1,3 % der Landesfläche)

Windenergie in 2009





Annahmen:

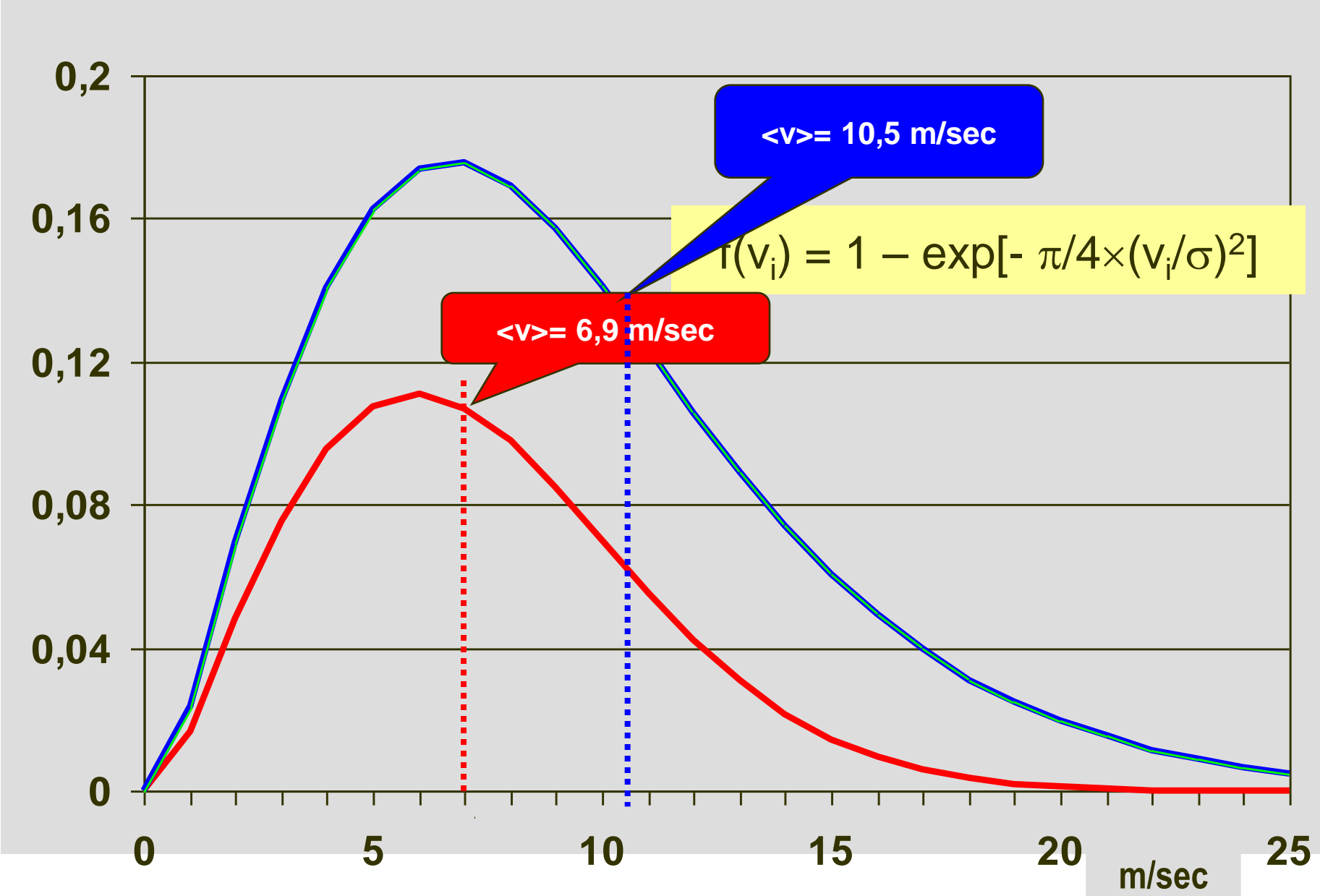
<V>	5,5 m/sec
Nabenhöhe	30 m
<u>Bodenrauigkeitslänge</u>	<u>0,1 m</u>

rechnerische Referenz: 100 !

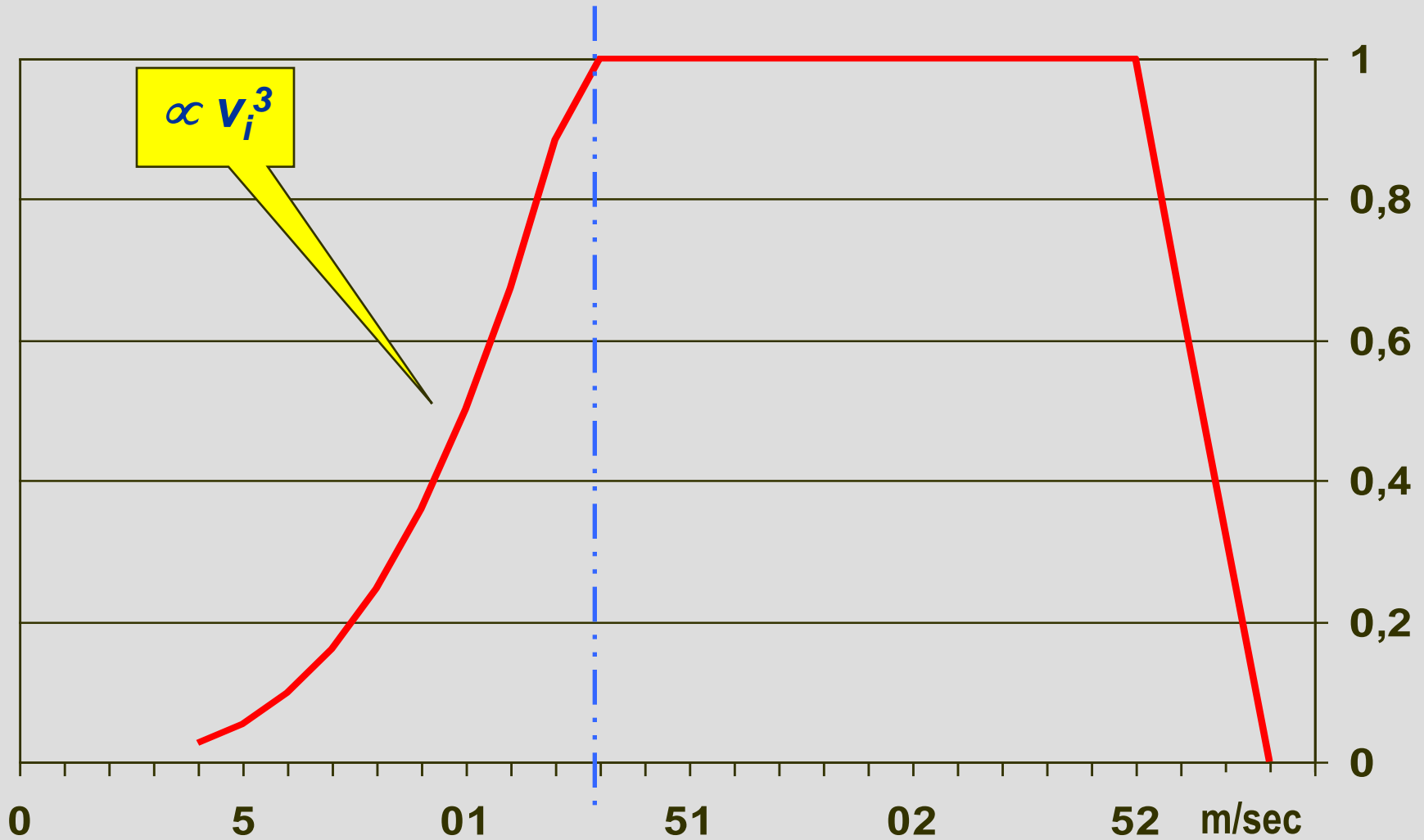
Ländervergleich:

1. Schleswig-Holstein	135
2. Sachsen-Anhalt	131
3. Niedersachsen	127

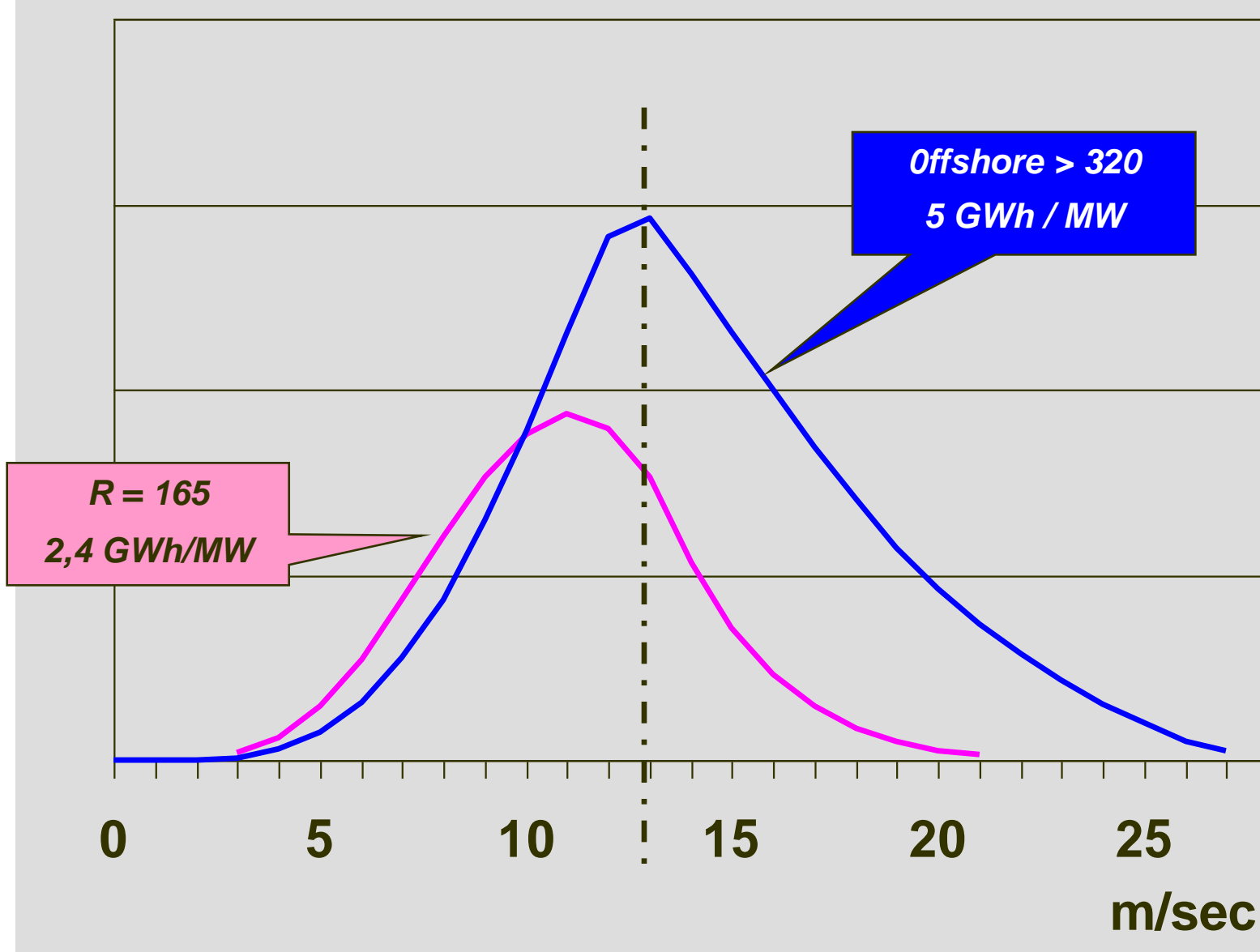
Rayleigh-Verteilung: $F_{i,i-1} = f(v_i) - f(v_{i-1})$



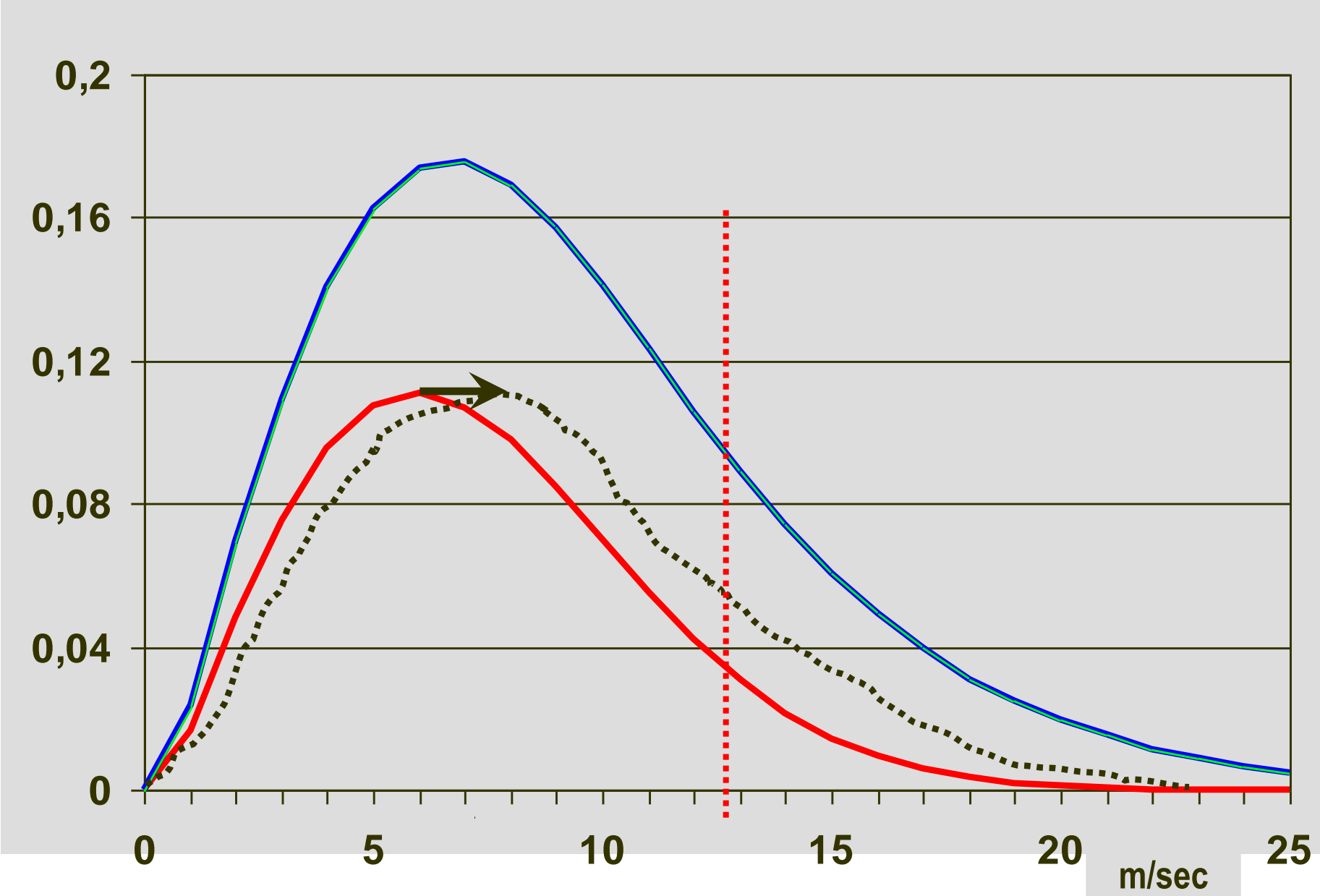
Leistungskennlinie $\therefore v_i < 25 \text{ m/sec}$



Faltung - Stromernte: GWh pro MW



Optionen aus der Rayleigh-Verteilung



Ostsee

Sky 2000

Nordsee: 1. Stufe

Butendiek

DanTysk

Nördlicher Grund

Sandbank 24

Amrumbank West

Nordsee Ost

Σ

125 MW
+ 5×5 MW as test-area

≥ 2015

240 MW

400 MW

400 MW

400 MW

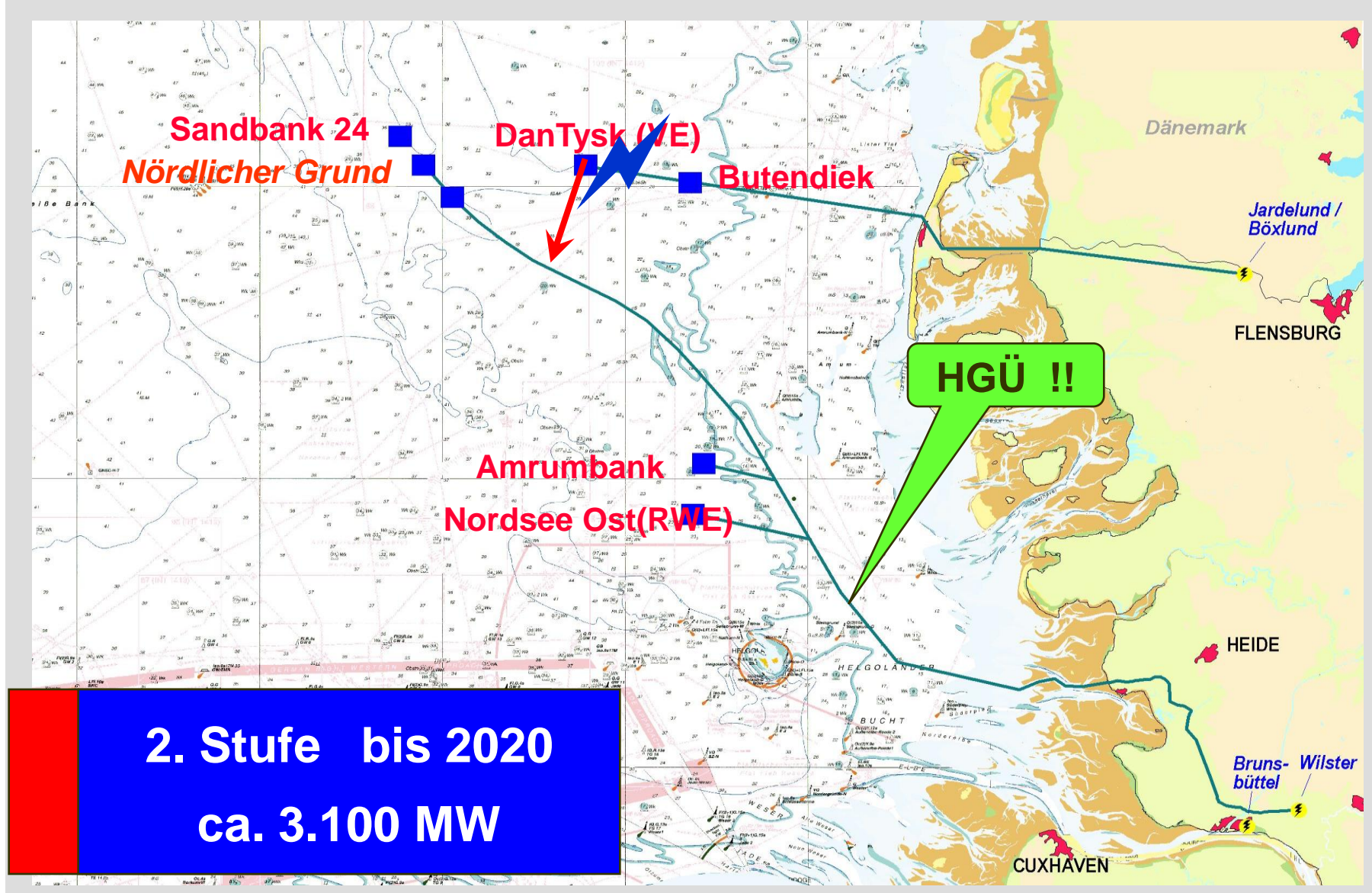
350 MW

400 MW

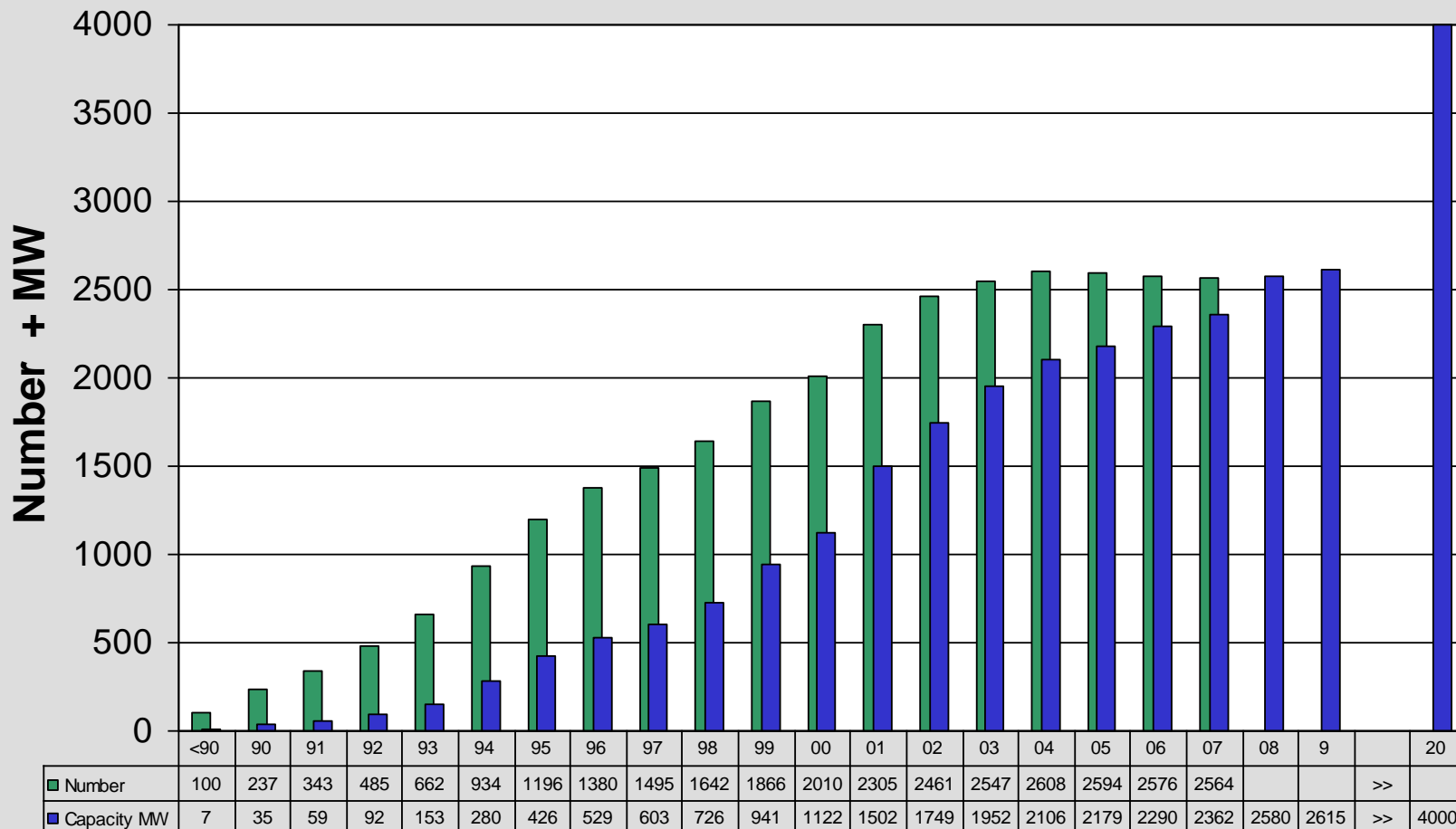
ca. 2200 MW



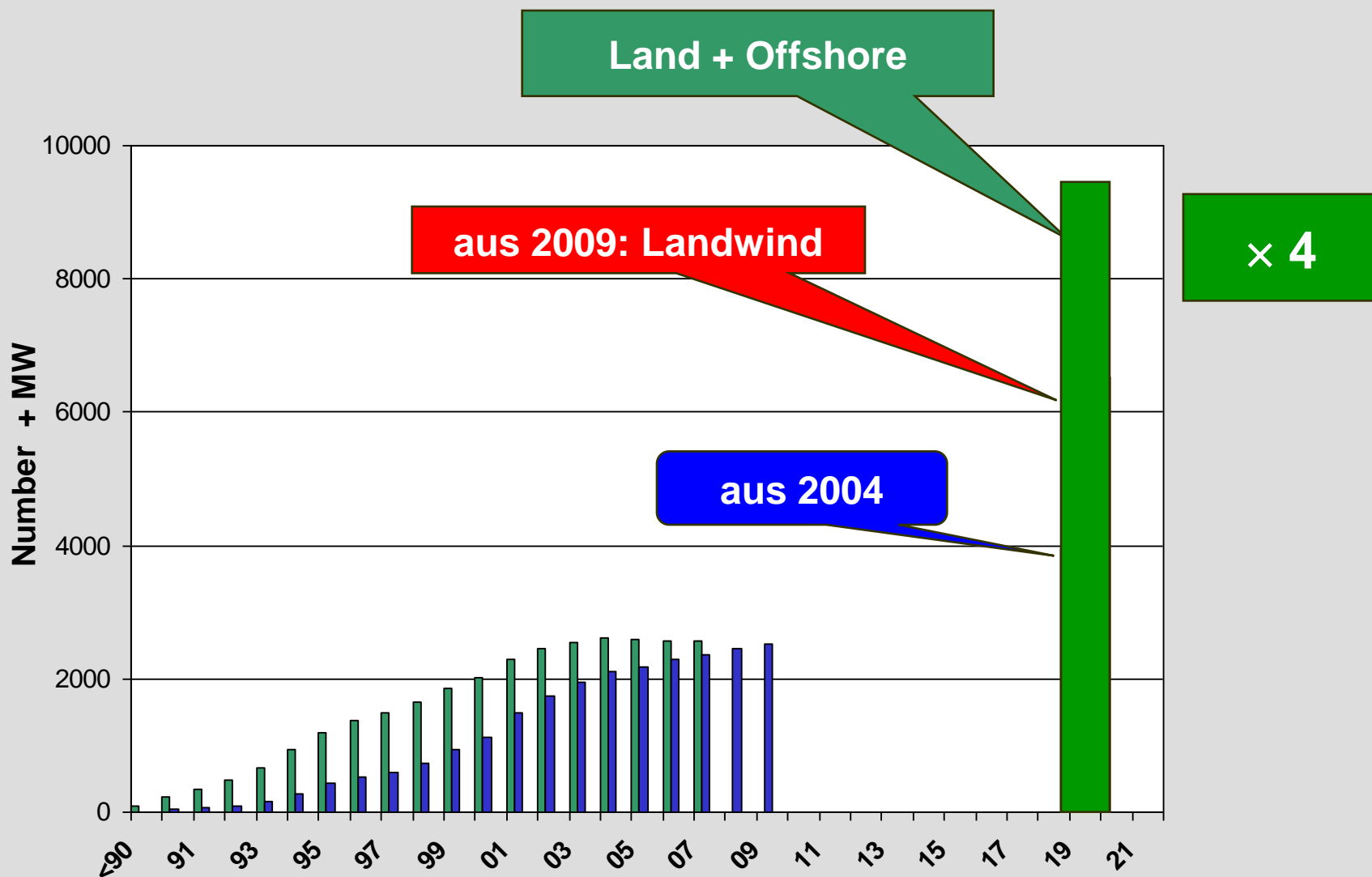
Netzkopplung aus Offshore



Windenergie in 2009



Windenergie in 2020



Stromerzeugung 2020

	MW	TWh	VLh : NLh
Landwind	6.500	15	2.300 : 600
Offshore	3.100	13	4.500 : 3.000
Summe	9.600	28	
Kernenergie	3.600	27	> 7.000
fossil, insb. Kohle ??	1.000 1.000	4 4	4.000 4.000
Summe	≈ 15.000	< 63	
Stromverbrauch 2009		13,5	
2020		≈ 15	



unsere energiepolitische Vision

rechnerisch

> 100 % Windstrom *

wird erreicht !!

*** Stromäquivalent !!**

Netzausbau

3 x	110 KV (2x Westküste, 1x Ostseeküste)	110 Km
	Nachrüstung Flensburg bis Hamburg-Nord	160 Km
	380 KV Elbquerung nach Niedersachsen	
+ 1 x	380 KV an der Westküste bis Hamburg	140 Km
	HGÜ: Brunsbüttel, Hamburg nach Hannover ?	ca. 350 Km

Super-grid

Norwegen → offshore → durch D → Wasserkraft in CH + A
als Nukleus

RENREN: Renewable ENergy REgions Network, Brüssel 2007

SH: Wind + OÖ: Biomasse waren Initiatoren

SüdS: Wasserkraft, CY: Solarthermie, IS: Geothermie + Wales: Gezeiten/Wellen

INTEREG IVc: genehmigt, 15 Partner

Schleswig-Holstein + [REDACTED]

[REDACTED] ??

Kick-off: 28.04.2010 in Kiel

Aber: Energiemix nicht vernachlässigen !

Danke für Ihre Aufmerksamkeit !

Gustav W. Sauer

Dr.rer.nat., Dipl.-Ing. (TUG)

Ministerialdirigent

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