

ISGT2010 in EU

*Paper session: Grid Integration of Renewable energy Source (III)*

# スマートグリッド国際会議出張報告

特任教授

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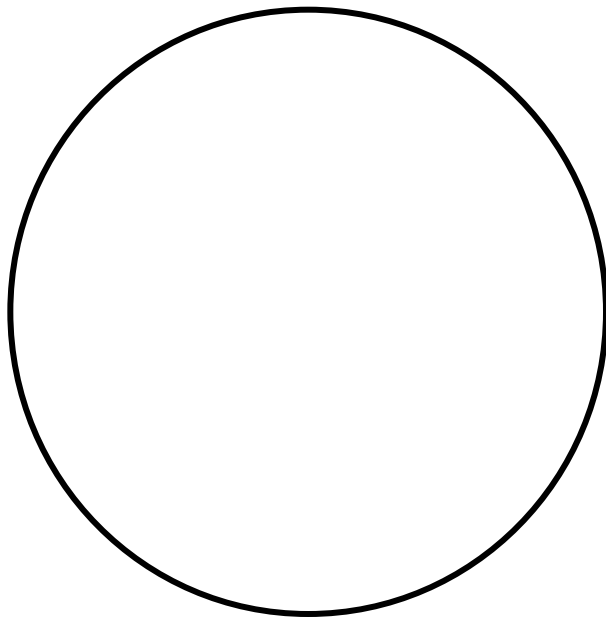
2010年11月10日

東京大学大学院 技術経営戦略学専攻

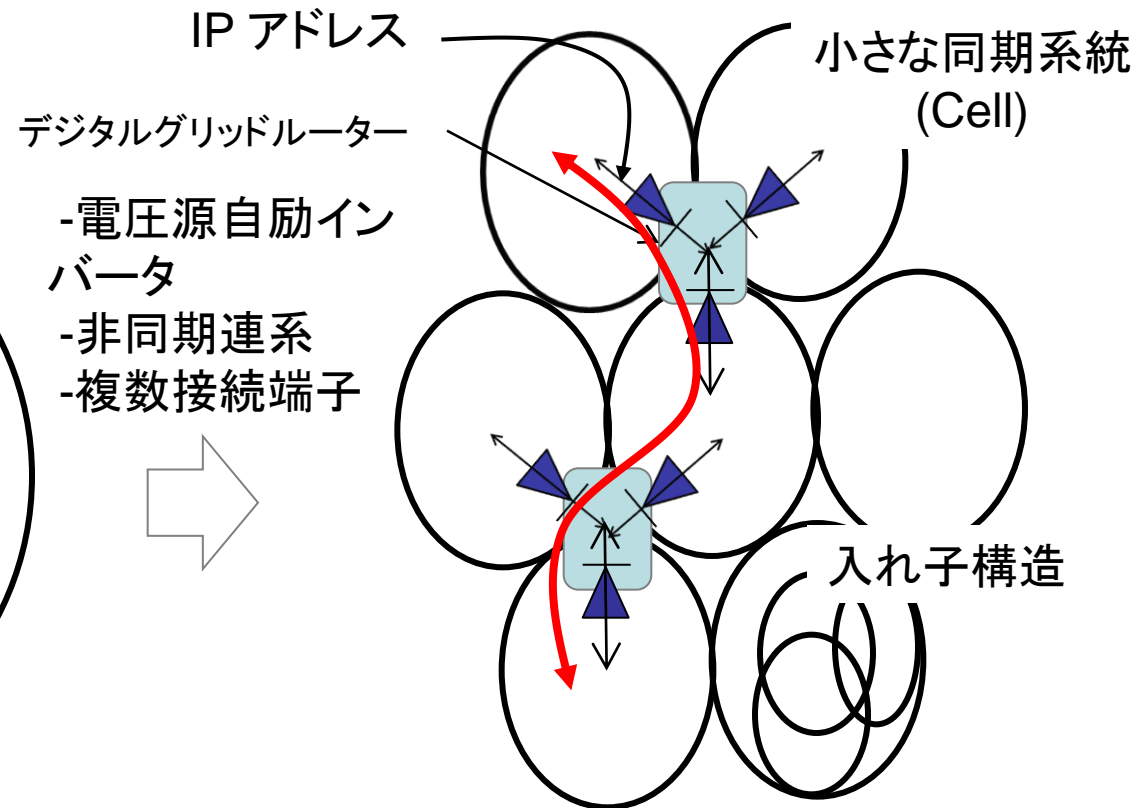
- 第一回欧州スマートグリッド会議における「デジタルグリッド」の発表
- 同会議の主たる話題(アラカルト)と背景
- ABB訪問:HVDC技術調査

# デジタルグリッドの概念

巨大同期電力系統

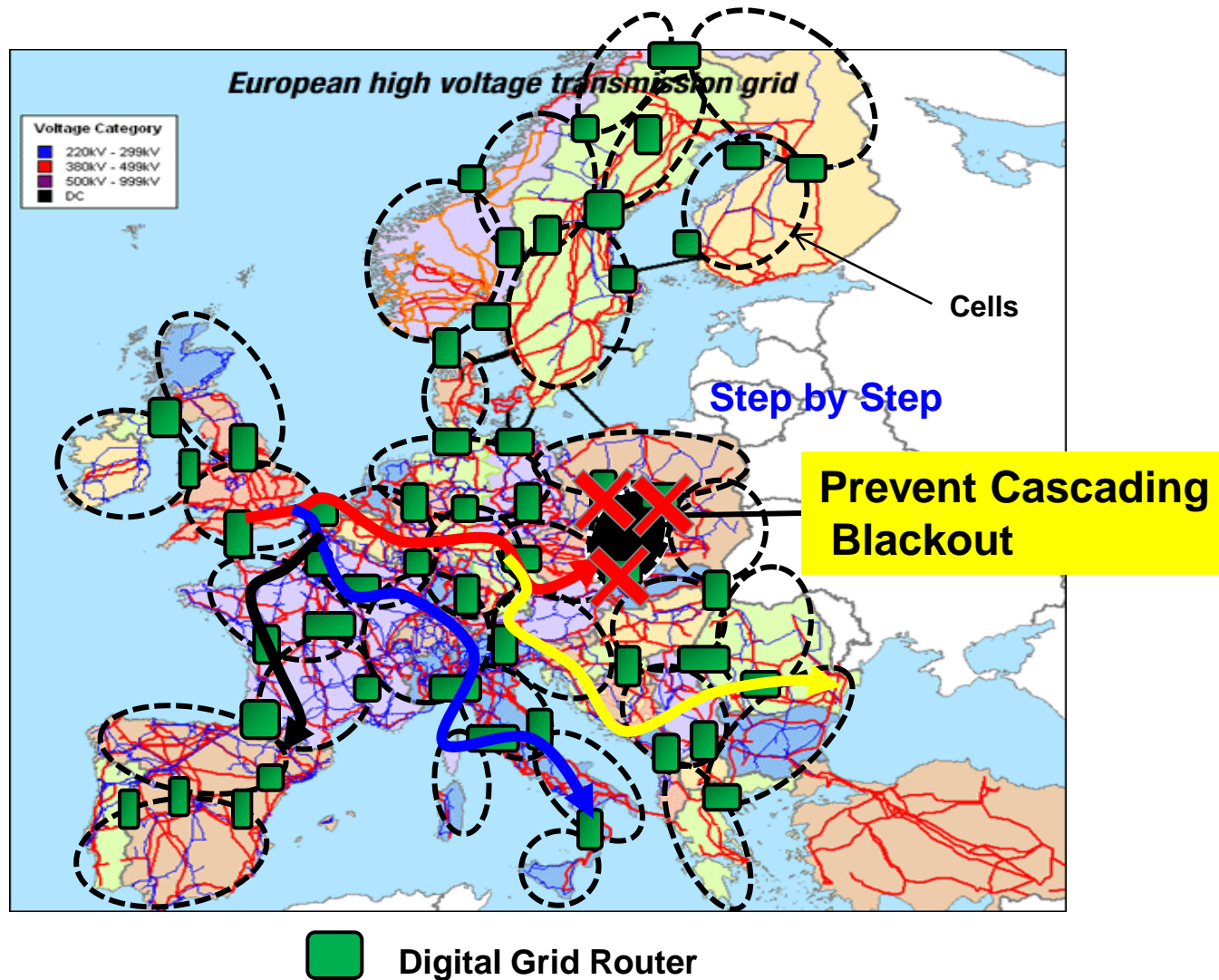


細分化された非同期電力系統



セルのサイズ: 地方単位, 州単位, 市単位, 工場単位, 家庭単位, etc.

# Proposed Digital Grid in EU



## 第一回欧州スマートグリッド会議の報告とその背景

## *Smart Grid Activities*

- Named Erich Gunther Member of the IEEE PES Smart Grid Activities
- Held 1<sup>st</sup> Innovative Smart Grid Technologies (ISGT) Conference in January 2010
  - Only 2 Months Notice
  - Over 700 Attendees from 32 Countries
  - 80% of Attendees were from Industry, 20% from Academia
- Innovative Smart Grid Technologies Conference in October 2010 in Gothenburg, Sweden
- 2<sup>nd</sup> Innovative Smart Grid Technologies Conference in USA in January 2011 in Anaheim, California

米国第1回は今年1月、  
米国ワシントン  
700人、32カ国

欧州の第1回は、今年10月  
スウェーデンヨーテボリ

米国の第2回は、来年1月  
米国, アナハイムの予定

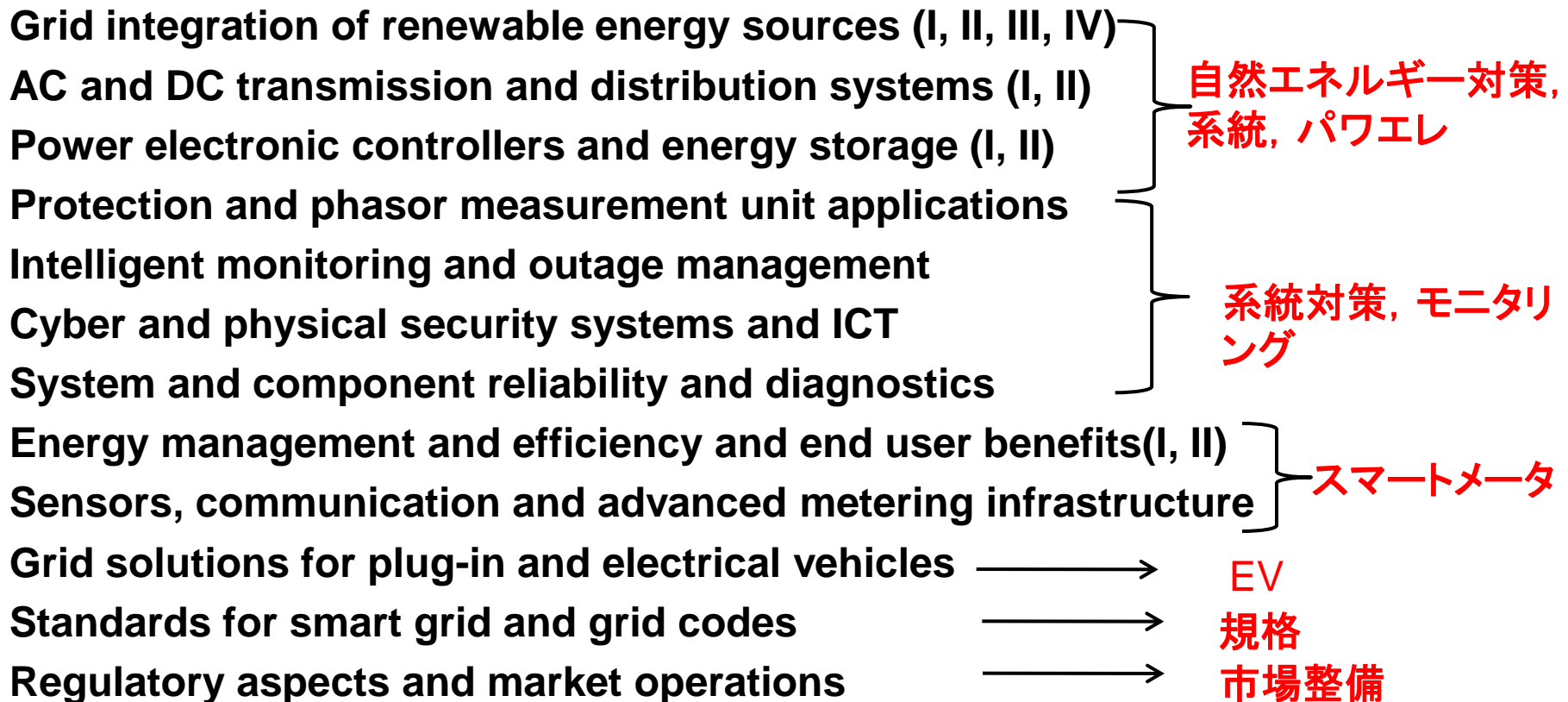
欧州スマートグリッド会議は第一回目、**435人、40か国**から参加者が集まり、150の論文提出があった。

テーマが再生可能エネルギー、電力貯蔵、電力変換技術に集中していた。

米国の今年の1月の会議とは相当様相が異なり、米国で中心的だったIT技術とスマートメーター、新ビジネスという側面はあまり表に出てきていない。

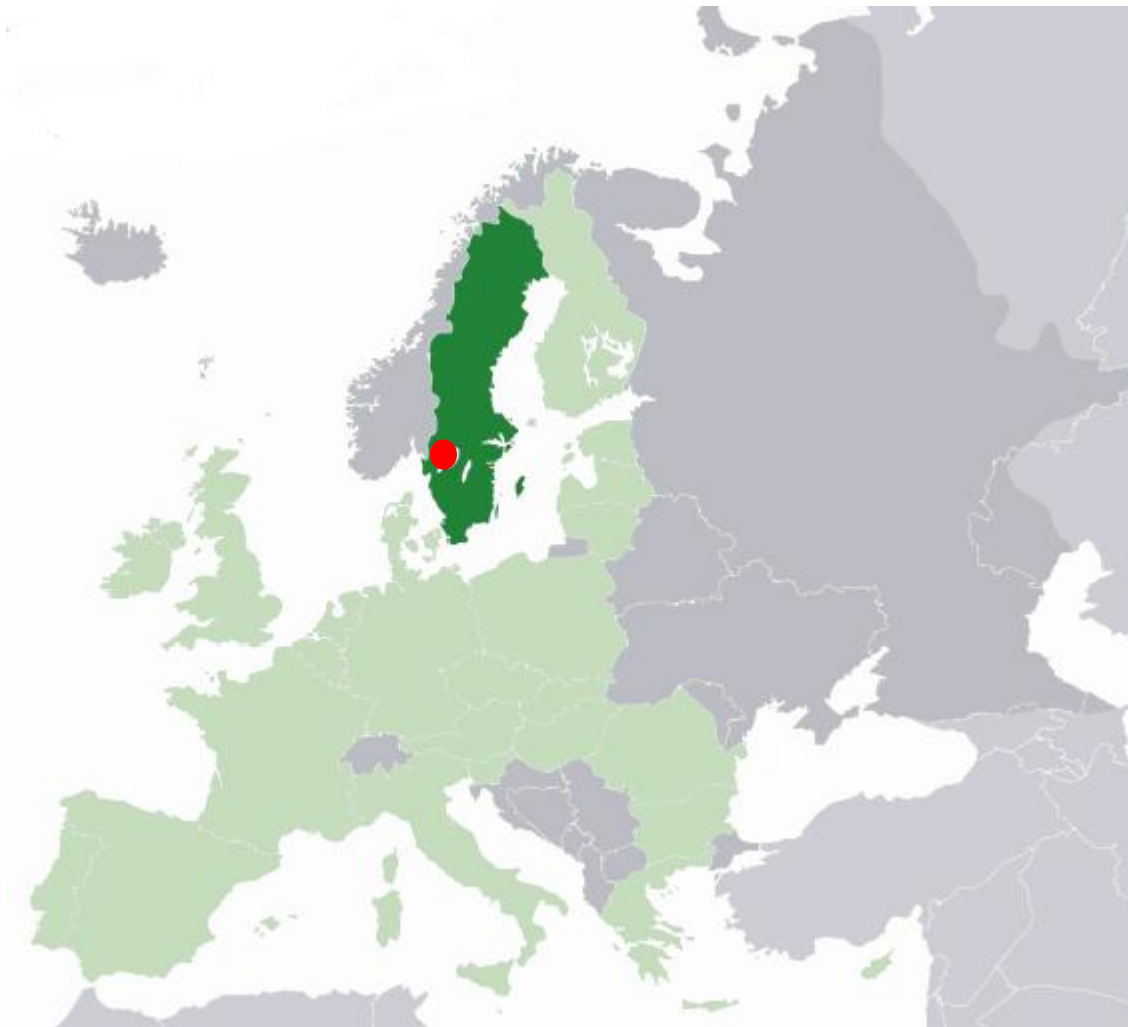
欧州でのポイントは、

- ・各国とも**再生可能エネルギー導入量が飛躍的に伸び**、今後もこの勢いは止まらない。
- ・一方**電力系統は脆弱**で、急いで強化する必要がある。
- ・発電の変動を吸収するのは、**電力貯蔵技術**であり、今後ますます重要不可欠になっていく。
- ・系統上もっともプロミッシングなのは、**HVDC(高圧直流送電)技術**だ。



# Innovative Smart Grid Technologies

Europe 2010, October 11-13, Gothenburg, Sweden



# 会場のあったGothenburg, Chamlers University

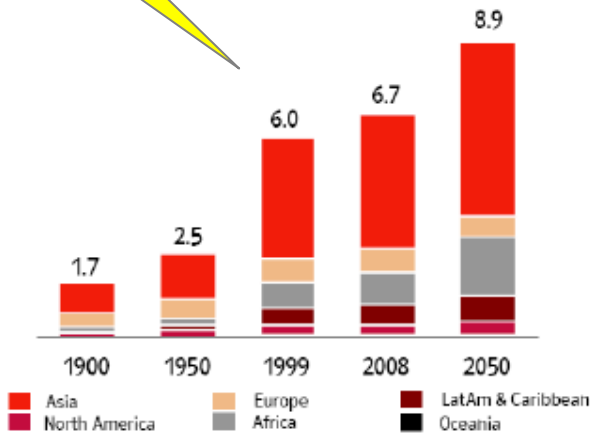


## Population growth and associated resource requirements are the largest challenge of our time

### Global population to hit 9 bn by 2050

人口の爆発  
特にアジア

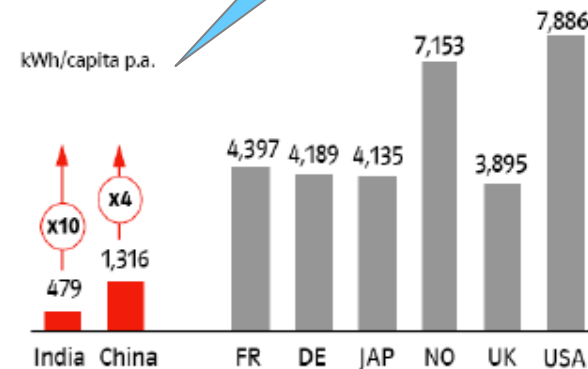
Majority of increase is expected to come from Asia  
 Pressure on energy resources and water supply  
 to intensify



### OECD energy consumption

エネルギー消費  
水準向上

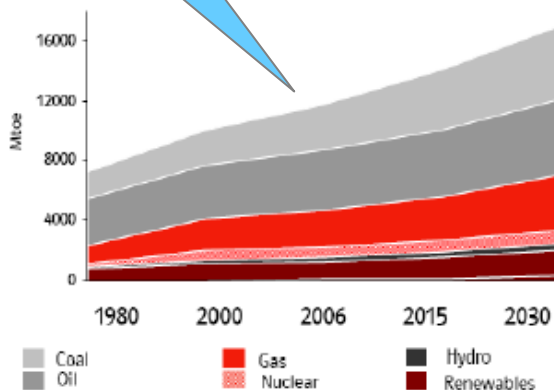
- Expectation that 80% of energy demand will be met by fossil fuels
- China is building over 100 coal fired plant per week in order to satisfy its rising energy demands



The increase in energy demand requires decarbonization of generation and enhanced end use

エネルギー需要は増加の一途

- Global energy demand**
- Rapid economic growth and further industrialization in Asia will drive energy needs
  - Primary energy demand set to rise at average of 1.6% per year to 2030

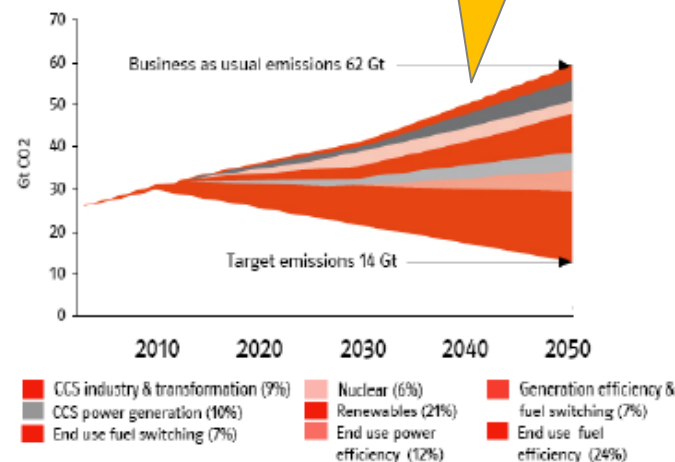


Source: IEA

## Technologies to tackle climate change

- Business-as-usual would lead to 62 Gt by 2050
- 14 Gt target consistent with 2°C warming target (450ppm)

再生可能エネルギーの拡大必要



Source: IEA 2008

## Initial propositions

Meeting on 8 and 9 March 2007, the [European Council](#) adopted new environmental targets even more ambitious than that of the [Kyoto Protocol](#).<sup>[5]</sup> The plan include the so-called "three 20 targets", but in reality it consisted in four proposals.

## Current Status

The European Council of 11 and 12 December 2008 definitively adopted the package, but modified the initial measures.

The 27 Heads of State and governments finally agreed to implement the 20-20-20 targets: by 2020,

- ✓ **reduce by 20% the emissions of greenhouse gases,**
- ✓ **increase by 20% the energy efficiency in the EU and to**
- ✓ **reach 20 % of renewables in total energy consumption in the EU.**

## ● Statements on Smart Grids

Directive 2009/72/EC of 13 July 2009

### □ Recital 21

Member States should encourage the modernisation of distribution networks, such as through the introduction of smart grids, which should be built in a way that encourages decentralised generation and energy efficiency.

スマートグリッドの導入

配電システムの近代化

### □

スマートメータープライシング  
で消費の最適化を

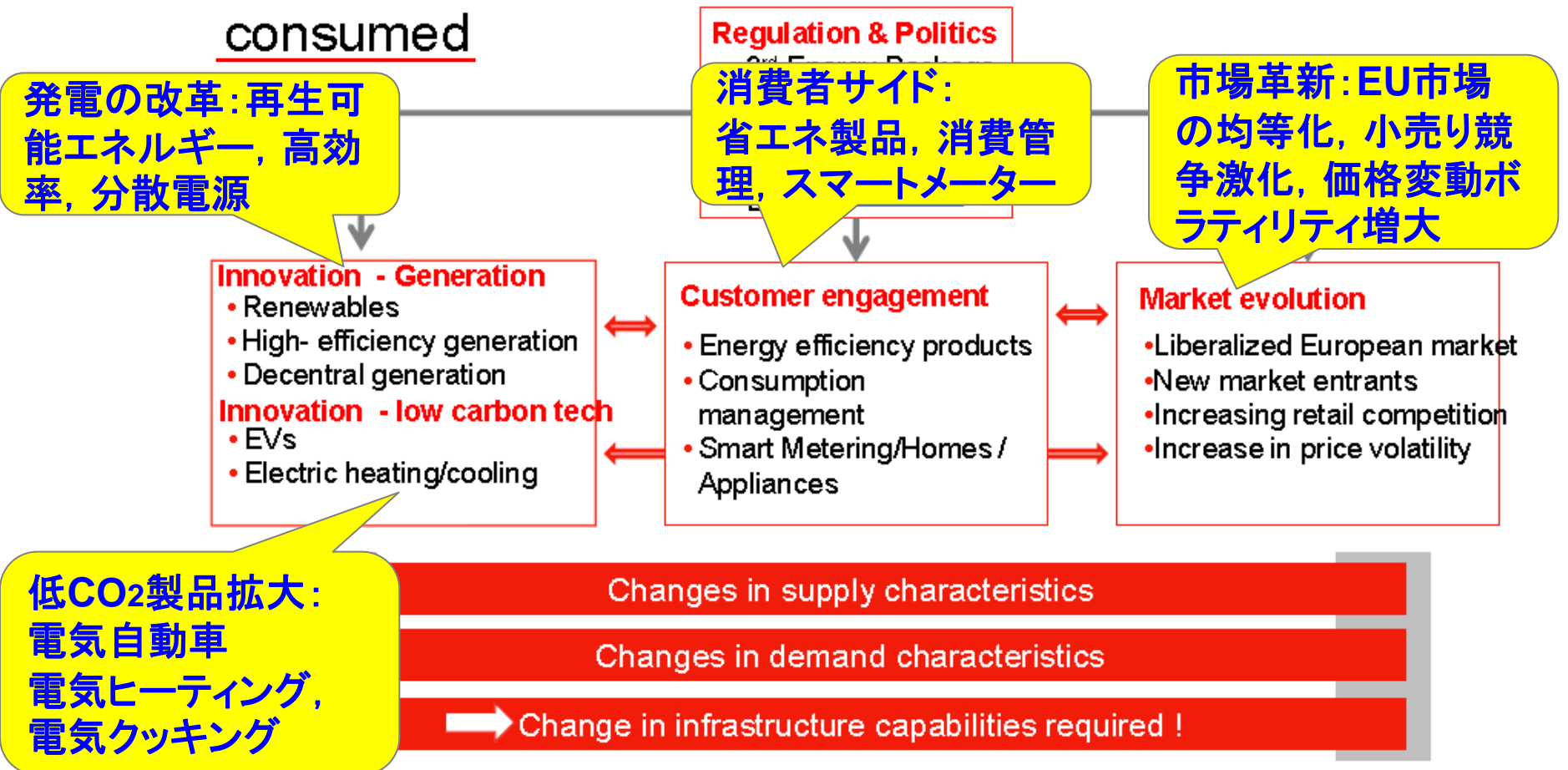
In order to promote energy efficiency, Member States, or where a Member State has so provided, the regulatory authority shall strongly recommend that electricity undertakings optimise the use of electricity, for example by providing energy management services, developing innovative pricing formulas or introducing intelligent metering systems or smart grids, where appropriate.

分散電源強化  
と熱効率向上

□ **Annex I:** Measures on Consumer Protection and preventions for the smart meters assessment by 2012 and roll-out by 2020.

# エネルギー生産と消費に大きな変化が

European efforts to address climate change are impacting largely the way energy is produced and consumed



# 自然エネルギーの増大/消費構造革新

Several examples from E.ON distribution businesses show that enhanced grid capabilities are required already today

Change in supply characteristics

**E.ON Spain – Distribution level**

wind

1998	25 MW
2009	1492 MW
2012	~3500 MW

風力発電の増大(Eonスペイン)

Change in supply characteristics

**E.ON Bavaria – Distribution**

level PV

2002	50 MW
2009	2000 MW
2010	~3000 MW

太陽光発電の増大(Eonドイツバーバリア)

Change in demand characteristics

**E.ON Westf. Weser – Smart Home**

Automated reduction of room temperature  
Automated adjustment of house lighting  
Tailored to customers life style and routine

消費スタイルの自動調整  
温度管理, 照明管理

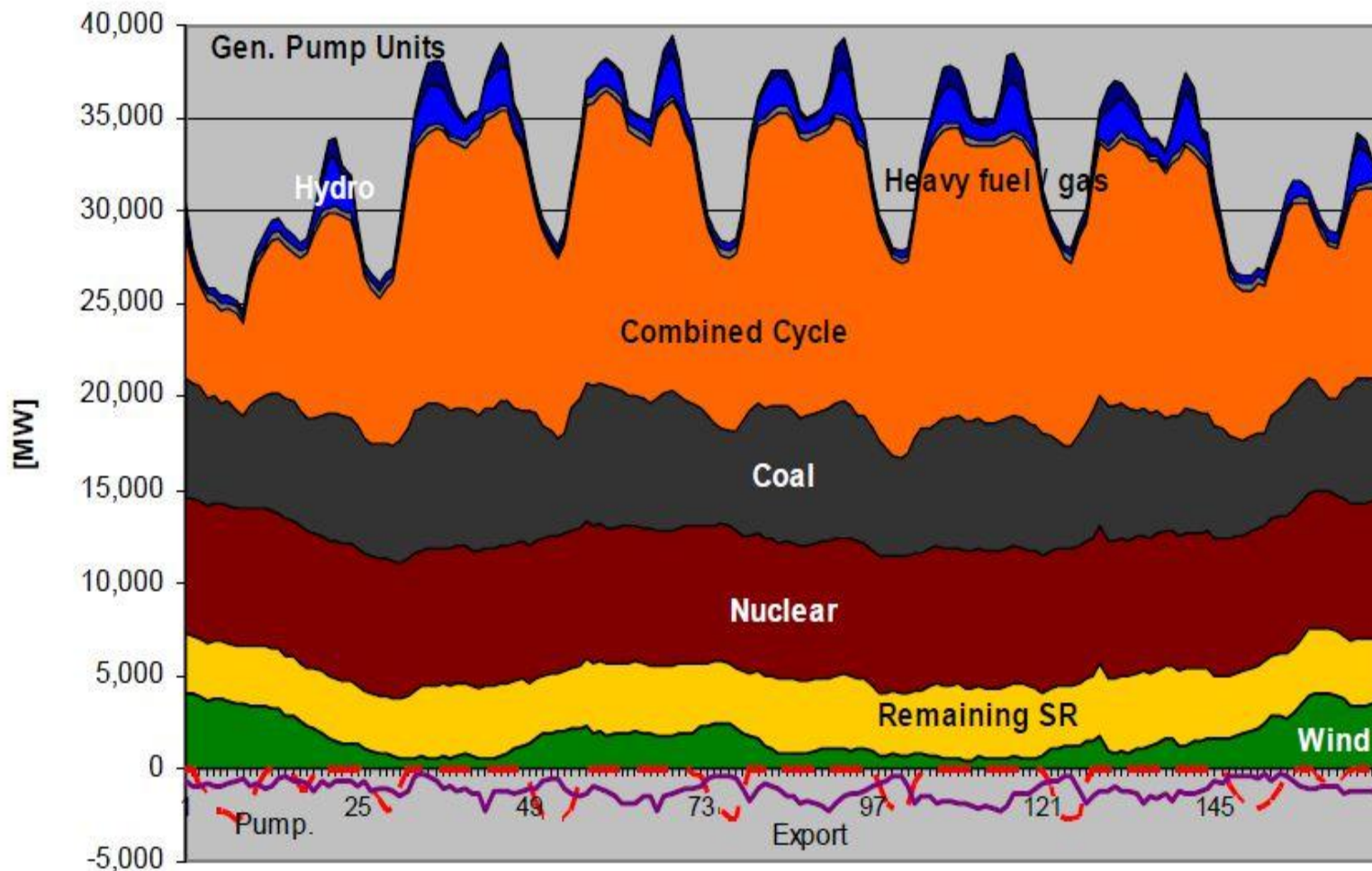
Energy landscape to change even more

environmental targets

Advancement of innovative technologies

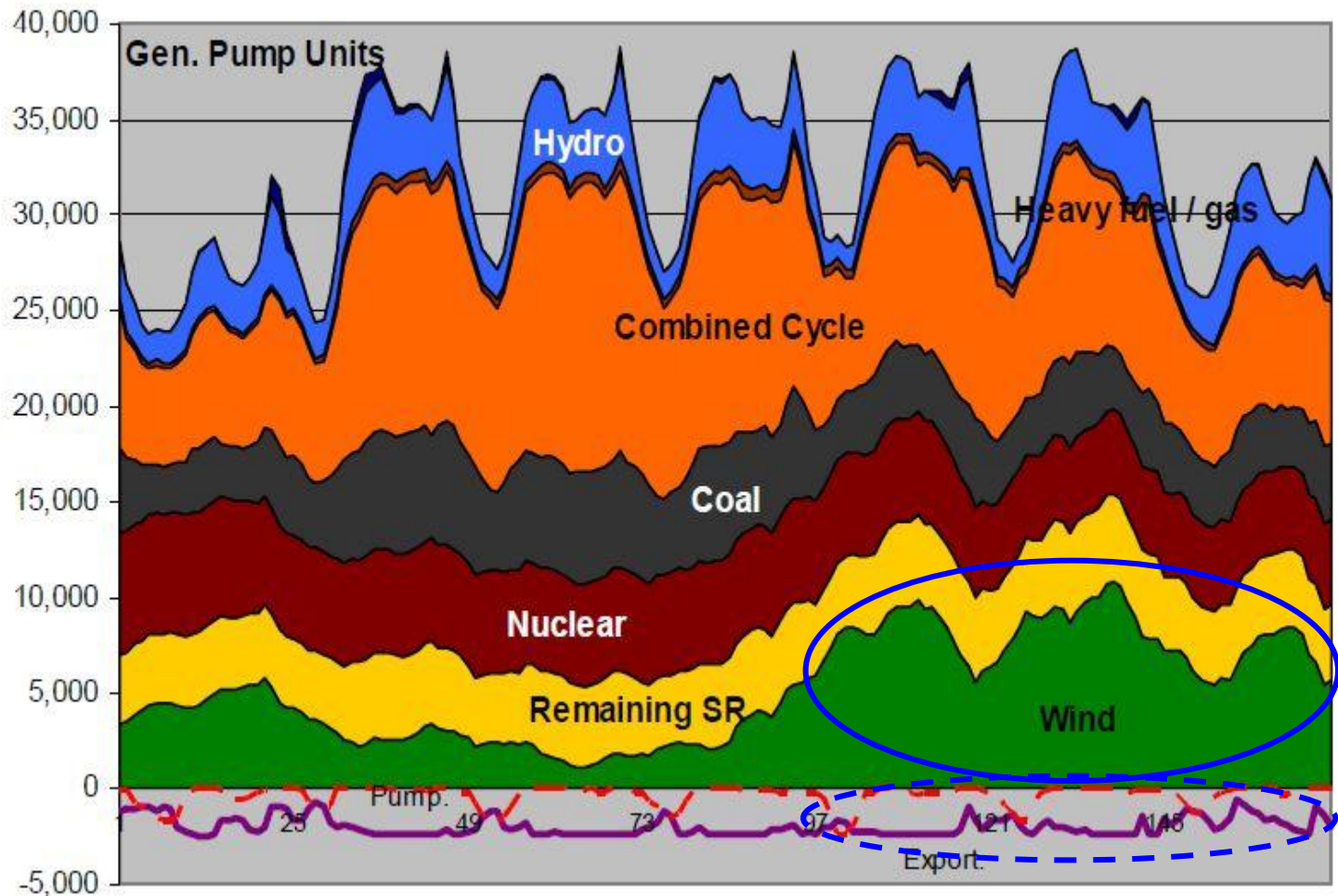
# スペインの1週間

## Spanish Demand Coverage - 24/02/2008 to 01/03/2008



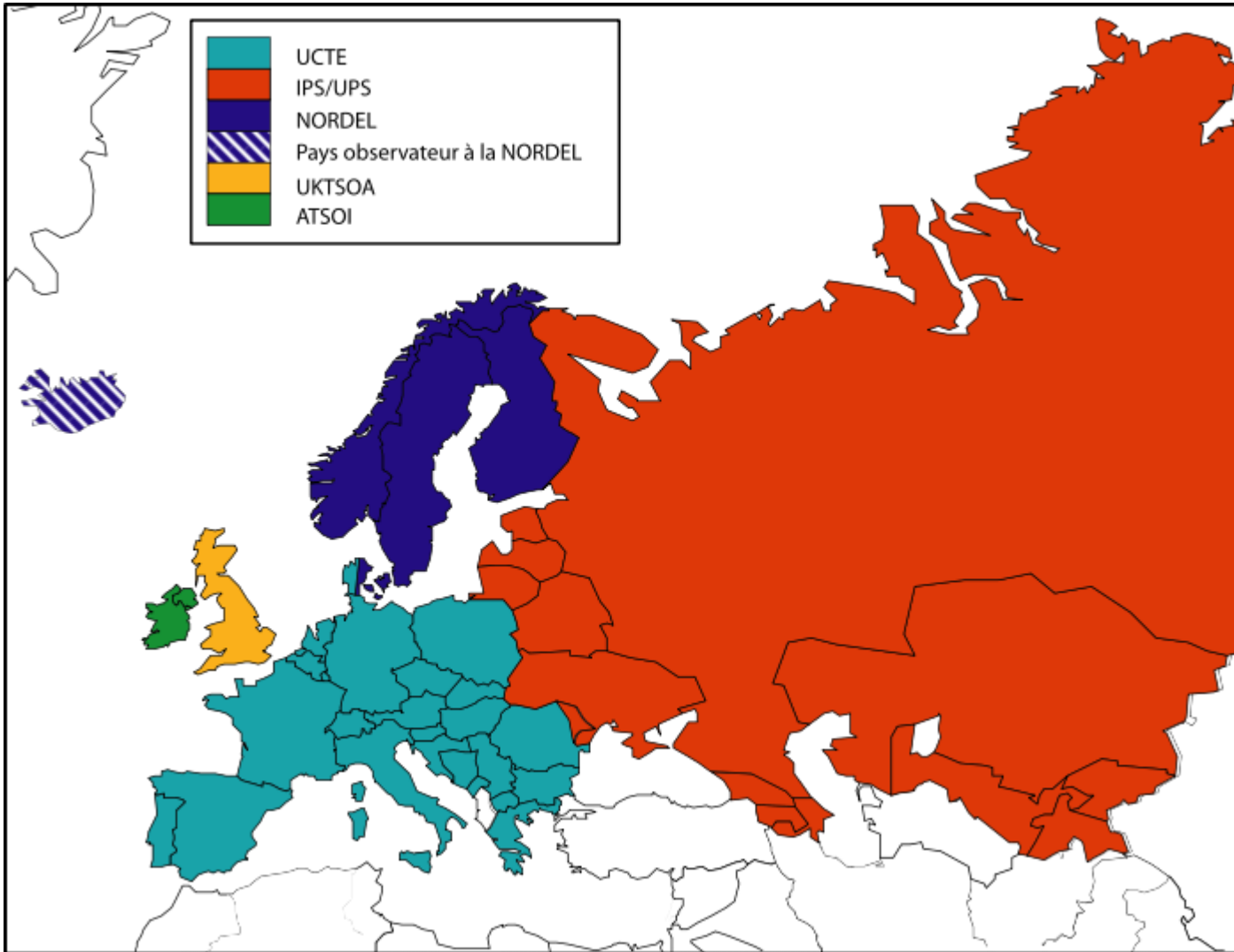
# 風力の増加をガスタービンと輸出でしのぐ

## Spanish Demand Coverage - 13/04/2008 to 19/04/2008



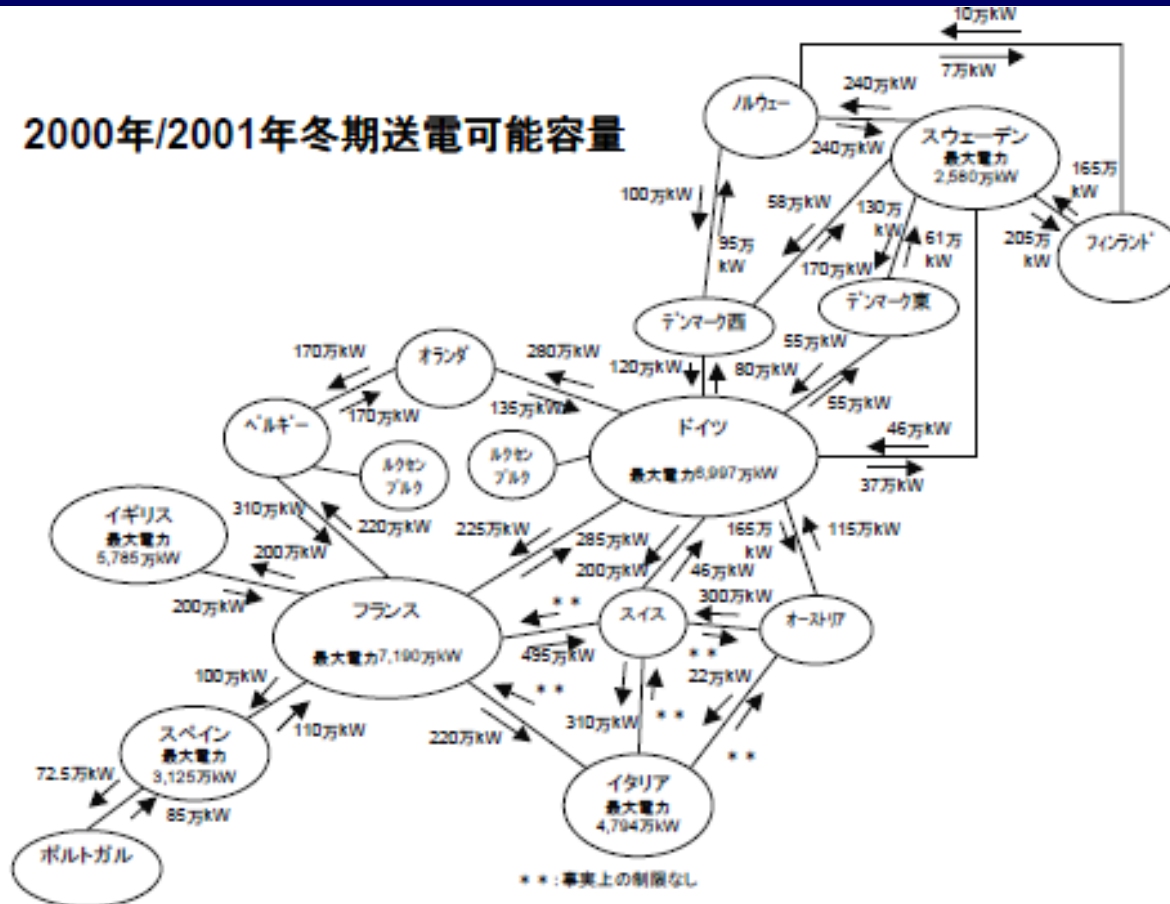
Integration of large scale wind in the grid – The Spanish Experience : RED

# 欧州の同期系統



# 欧州の送電電力容量

2000年/2001年冬期送電可能容量



(注1) ETSO(欧州系統運用者協会)では、年2回(夏期、冬期)国際連系線の送電可能容量を公開している。

(注2) 東欧・ロシア、北アフリカ地域との連系容量は記載していない。

(出所) ETSO, "Indicative values for Net Transfer Capacities ( NTC ) in Europe Winter 2001 - 2002, working day, peak hours", 2001年10月

# イギリスの送電網



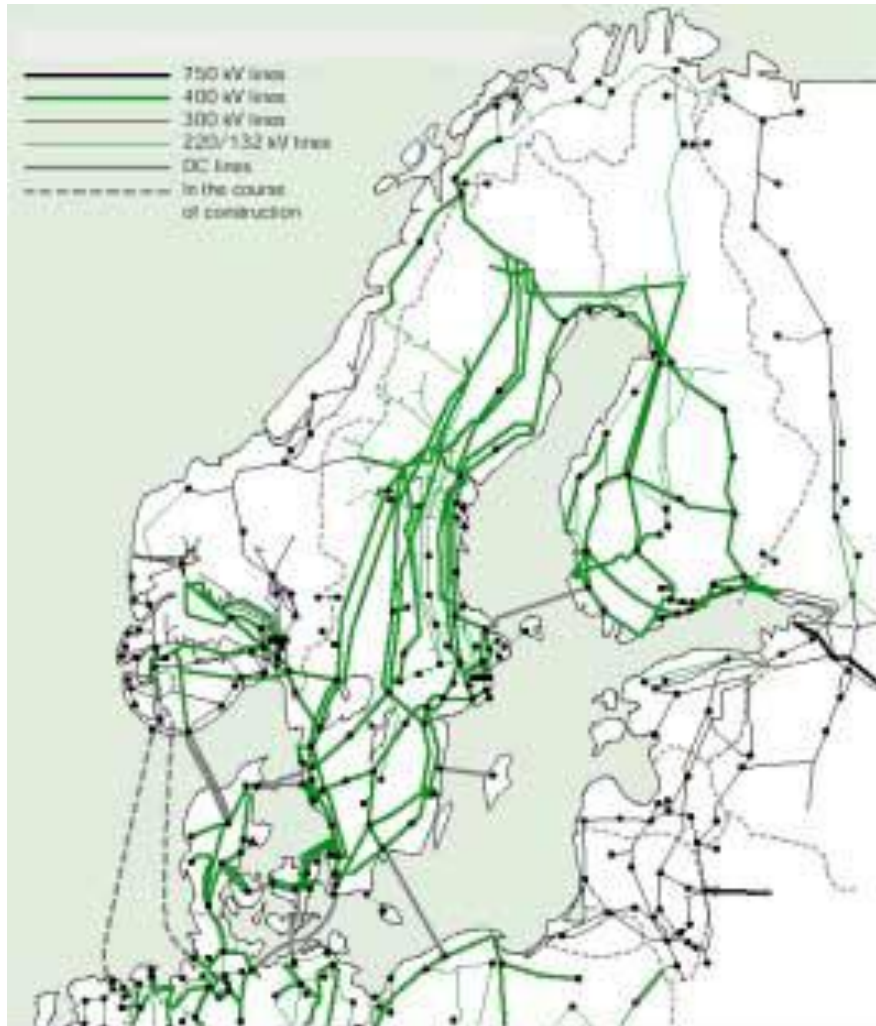
# フランスの送電網



# ドイツの送電網

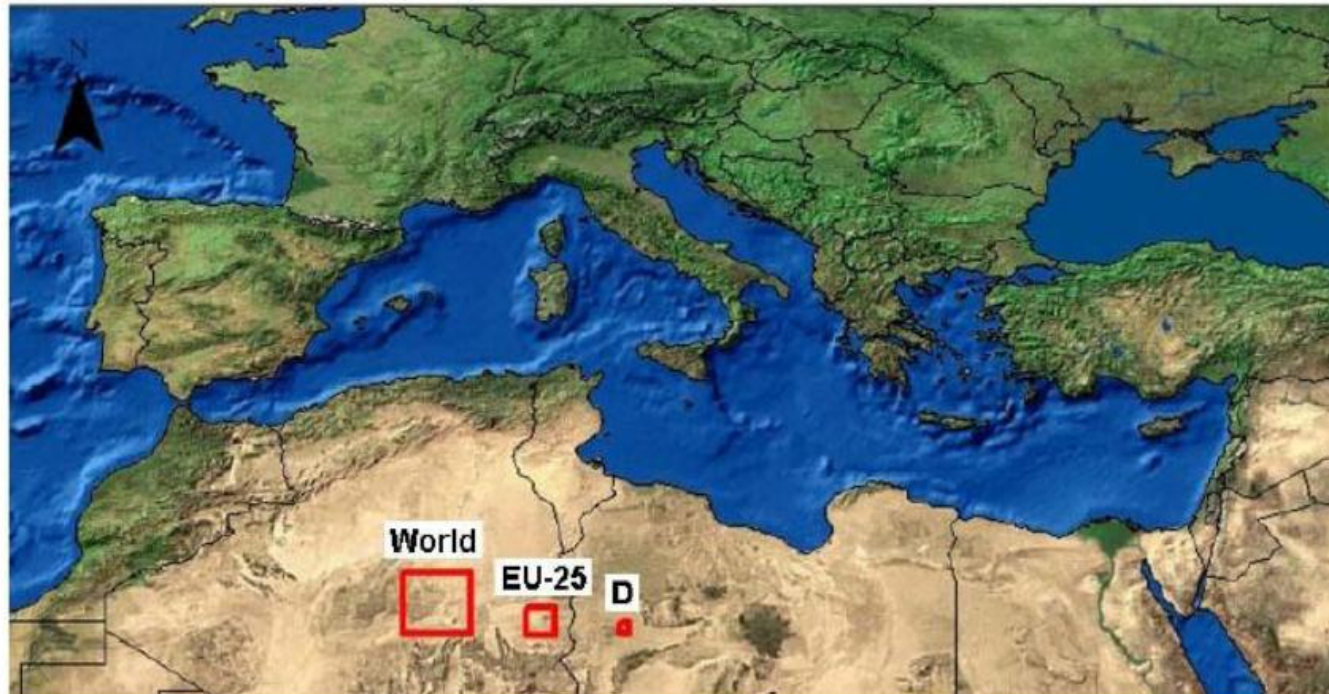


# 北欧の送電網



Solar power is the biggest renewable energy-resource by far

## Economic renewable electricity potentials vs. demand in Europe and MENA



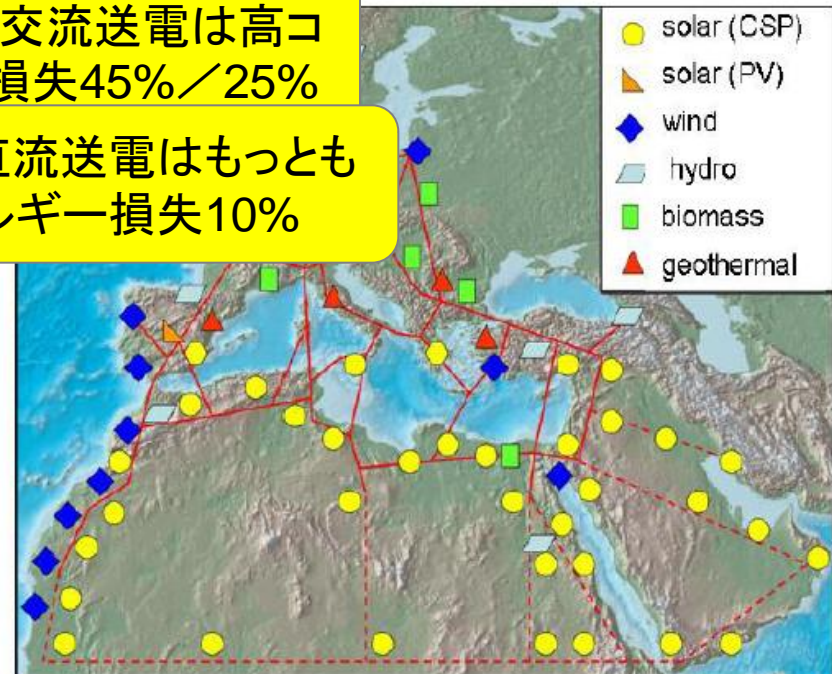
## Supergrid, or how the energy reaches the customer

水素製造・燃料電池発電は高コストでエネルギー損失75%

交流送電・超高圧交流送電は高コストでエネルギー損失45%/25%

800km超高圧直流送電はもっとも低コストでエネルギー損失10%

- Hydrogen electrolysis: very high energy losses
- AC / HVAC lines: high costs and 45% / 25% energy losses
- 800 kV HVDC lines: lowest costs and 10% energy losses



www.desertec.org

# ABBのHVDC技術 (資料削除)

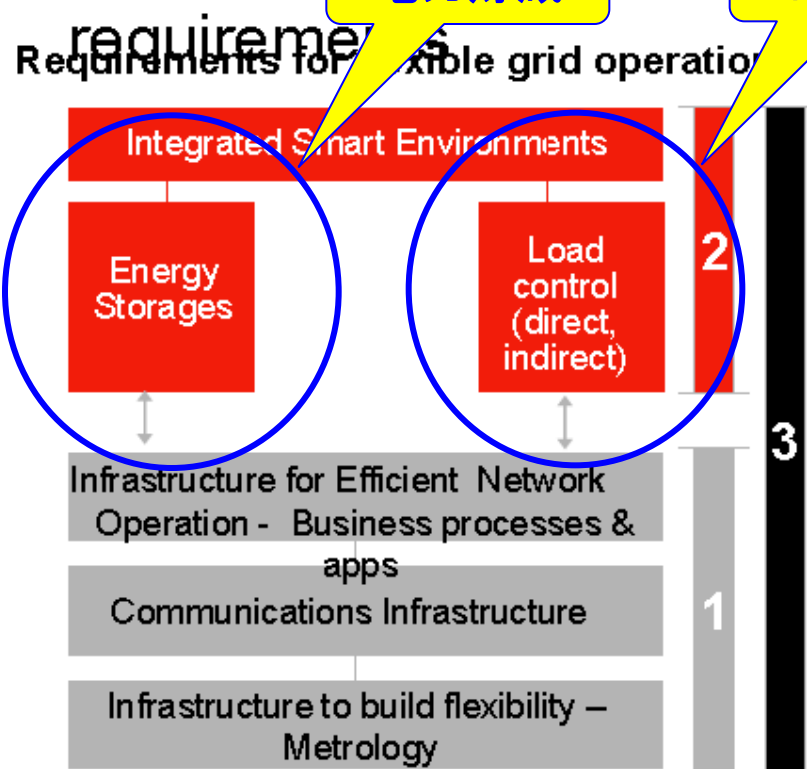
## 第一回欧州スマートグリッド会議報告に戻って

# ネットワークインフラの柔軟性革新

The network infrastructure of tomorrow must exhibit a high level of flexibility to meet changing requirements for flexible grid operation

電力貯蔵

消費制御



## What E.ON is doing in RD&D

1. Developing technical excellence in operation of new assets and systems

2. Defining and demonstrating how the distribution business can use "active" tools to enhance flexibility

3. Exploring how to most effectively integrate high efficiency distribution with active tools

## カリフォルニアで電力貯蔵義務付け法案にサイン

State of California • Department of Justice  
OFFICE OF THE ATTORNEY GENERAL  
Edmund G. Brown Jr.

## News Release

September 29, 2010

FOR IMMEDIATE RELEASE

Contact: (510) 622-4500

### **Brown Lauds Passage of the Nation's First Energy Storage Bill**

SACRAMENTO - Attorney General Edmund G. Brown Jr. today hailed the signing of AB 2514 (Skinner), the country's first energy storage bill, as "a major step towards energy independence."

Brown sponsored the new law to facilitate the development of solar and wind power, create jobs and increase California's energy independence by providing a mechanism for storing wind and solar power for use at times it can't be generated, such as nighttime. Governor Schwarzenegger signed the bill this afternoon.

"Californians want clean, renewable energy, and energy storage is an important part of that," said Brown. "This law will help reduce global warming emissions, improve air quality, and will be a major step towards energy independence."

The law will jumpstart the state's energy storage industry and lead to the creation of up to 10,000 manufacturing jobs, according to the California Energy Storage Alliance. Companies already have invested in some technologies for storing energy, such as using a thermal reserve or pumped hydroelectricity. Newer technologies include storing energy in various kinds of large-scale batteries, transforming it into flywheels and compressing it into air fields.

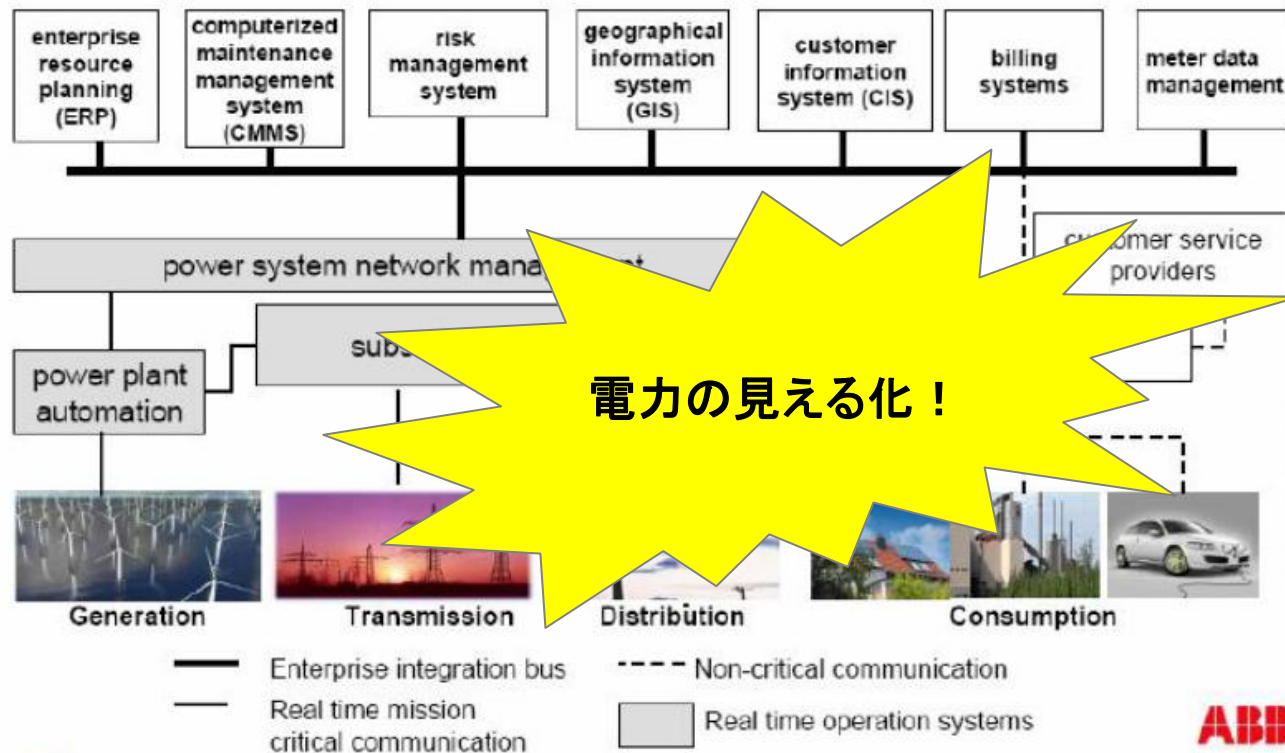
Energy storage is important for an expanding renewable energy future because solar and wind power are not available at all times. Increasing storage allows California to take greater advantage of its renewable resources while making our electric power grid more reliable.

Expanded storage will also protect public health by reducing the need for the most polluting "peaker plants" that only operate during peak demand, usually during the summer when air conditioners in the state are in most intense use.

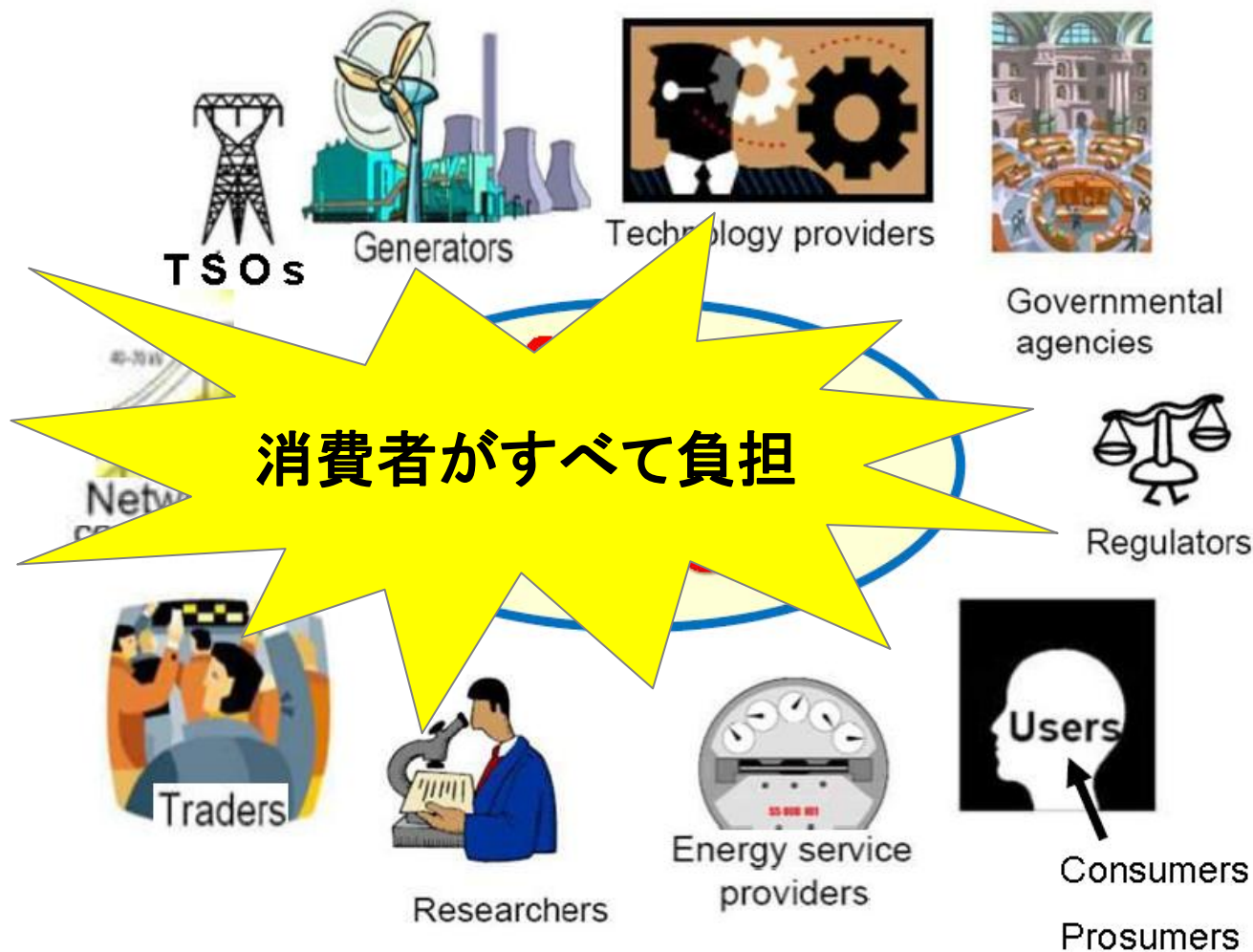
Attorney General Brown has fought to protect California's environment and worked to build a clean-energy infrastructure for the 21st century. He has successfully defended the state's landmark clean cars law, leading to improvements in fuel efficiency nationwide, and has worked with local governments to ensure that their long-term growth plans improve air quality by reducing traffic and greenhouse gas pollution. For more information, please see: <http://ag.ca.gov/globalwarming/>

## 再び第一回欧州スマートグリッド会議報告に戻って

## Smart Grid Solutions Automation/IT configuration



# 誰が受益者で誰が負担するのか？



# 第1回欧州スマートグリッド国際会議報告

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2010年11月10日

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