INCENTIVISING SMART GRID PILOTS
Regulatory experience in Italy

Regional Workshop on Smart Grid Deployment in the Danube Region
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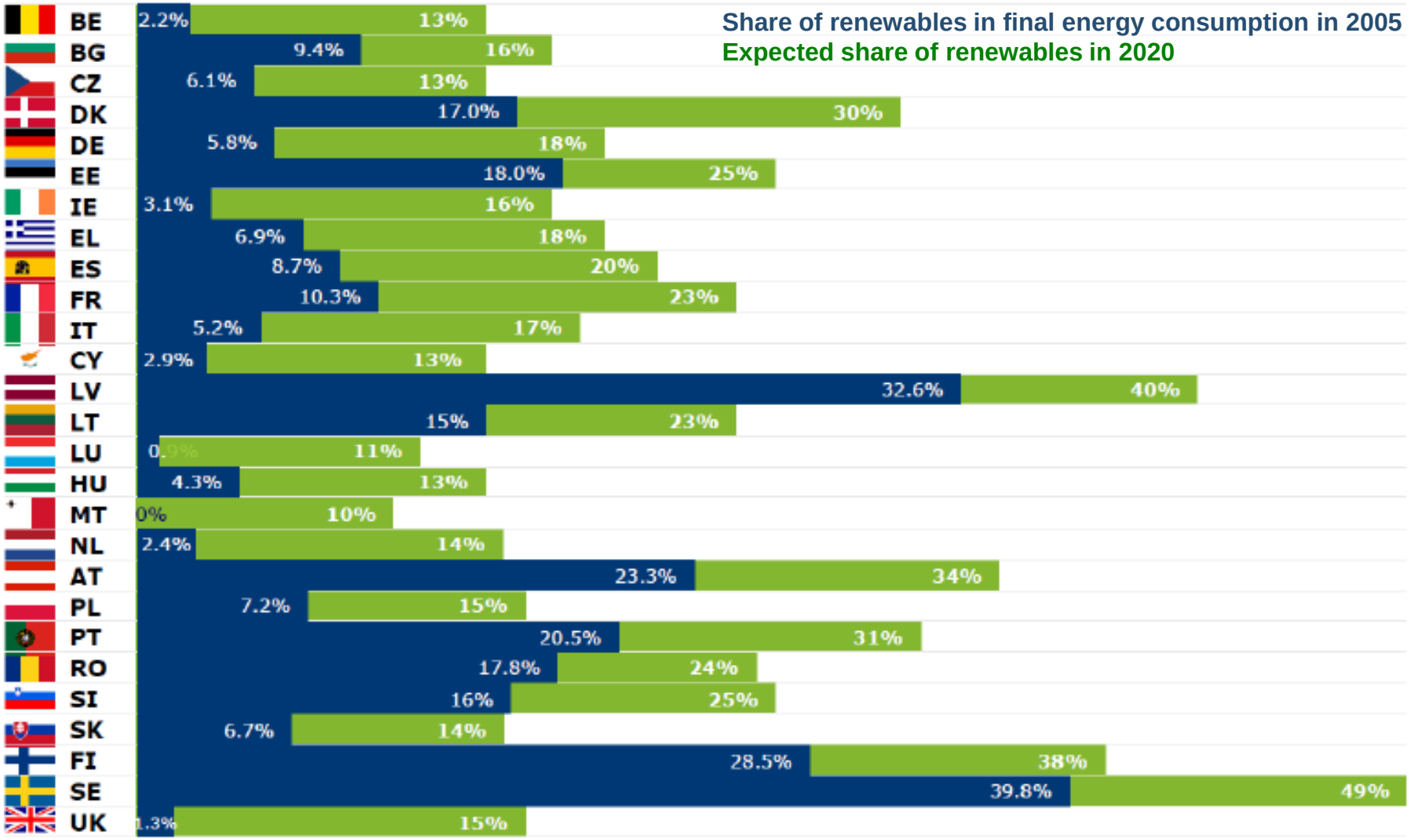
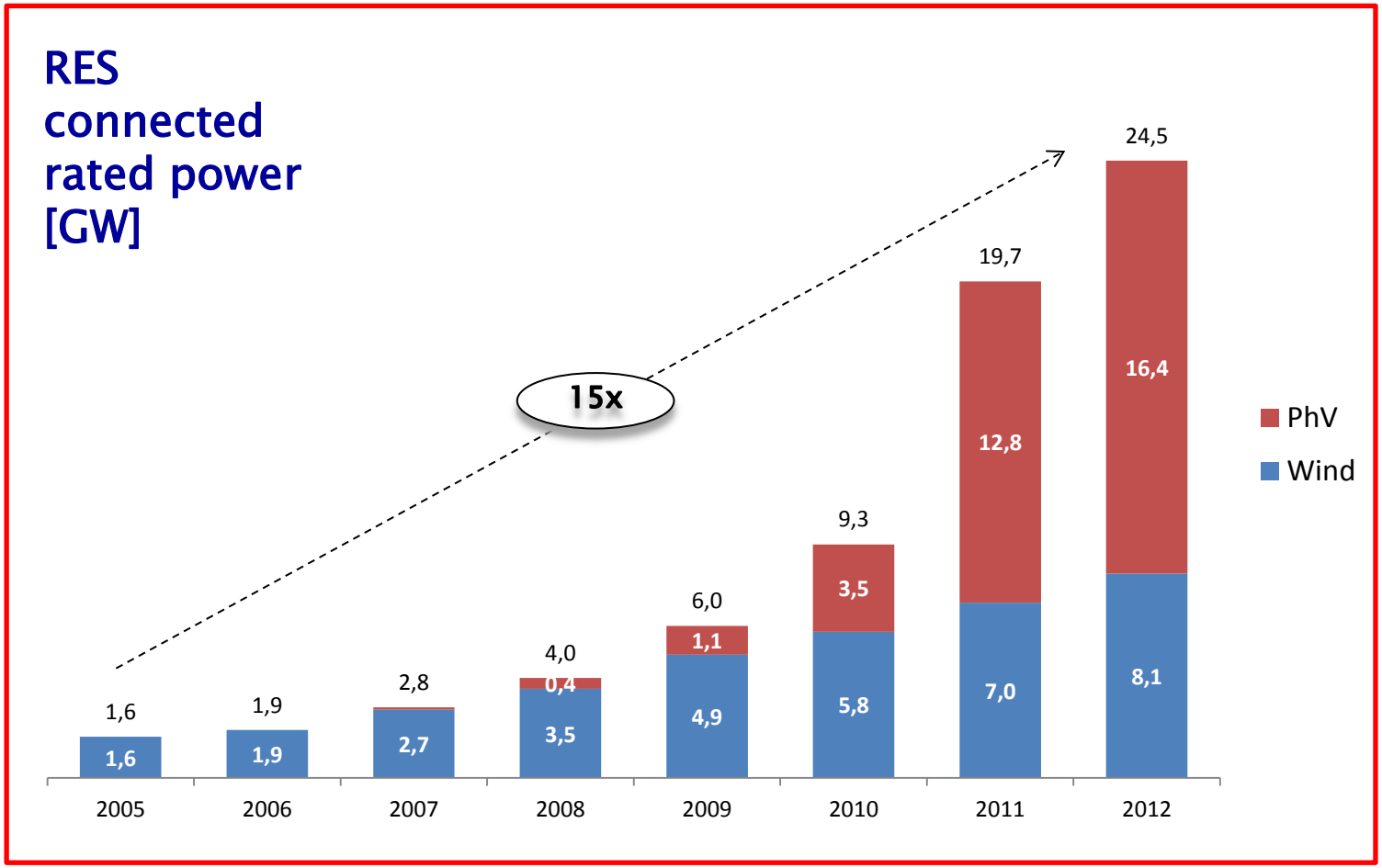
EU ENERGY POLICY "20-20-20"

National renewable energy targets



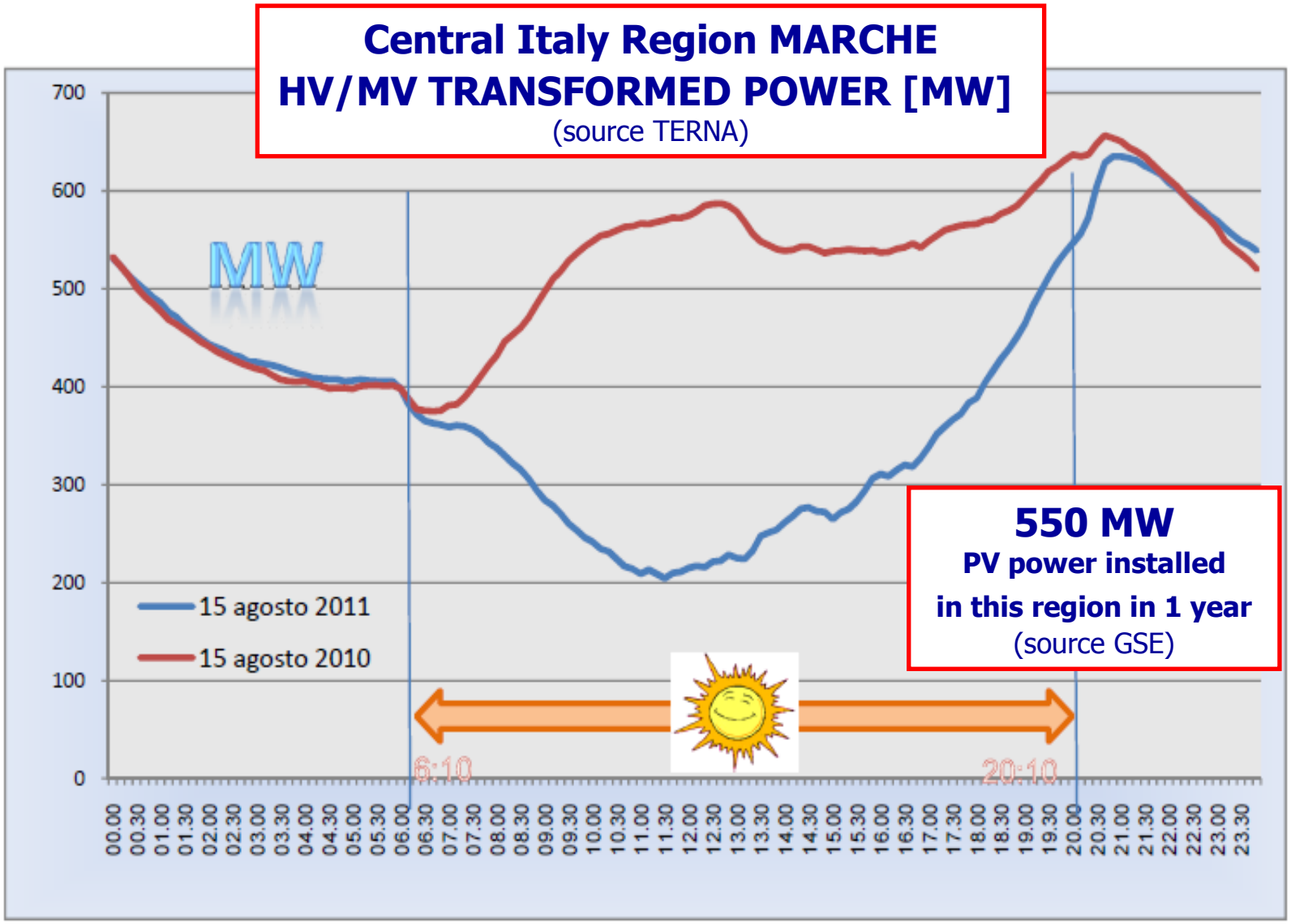
RENEWABLES HIGH PENETRATION:
The challenge for the power system



Italian Power System:
51 GW (peak), 22 GW (valley), 35 Ml users, 330 TWh/y

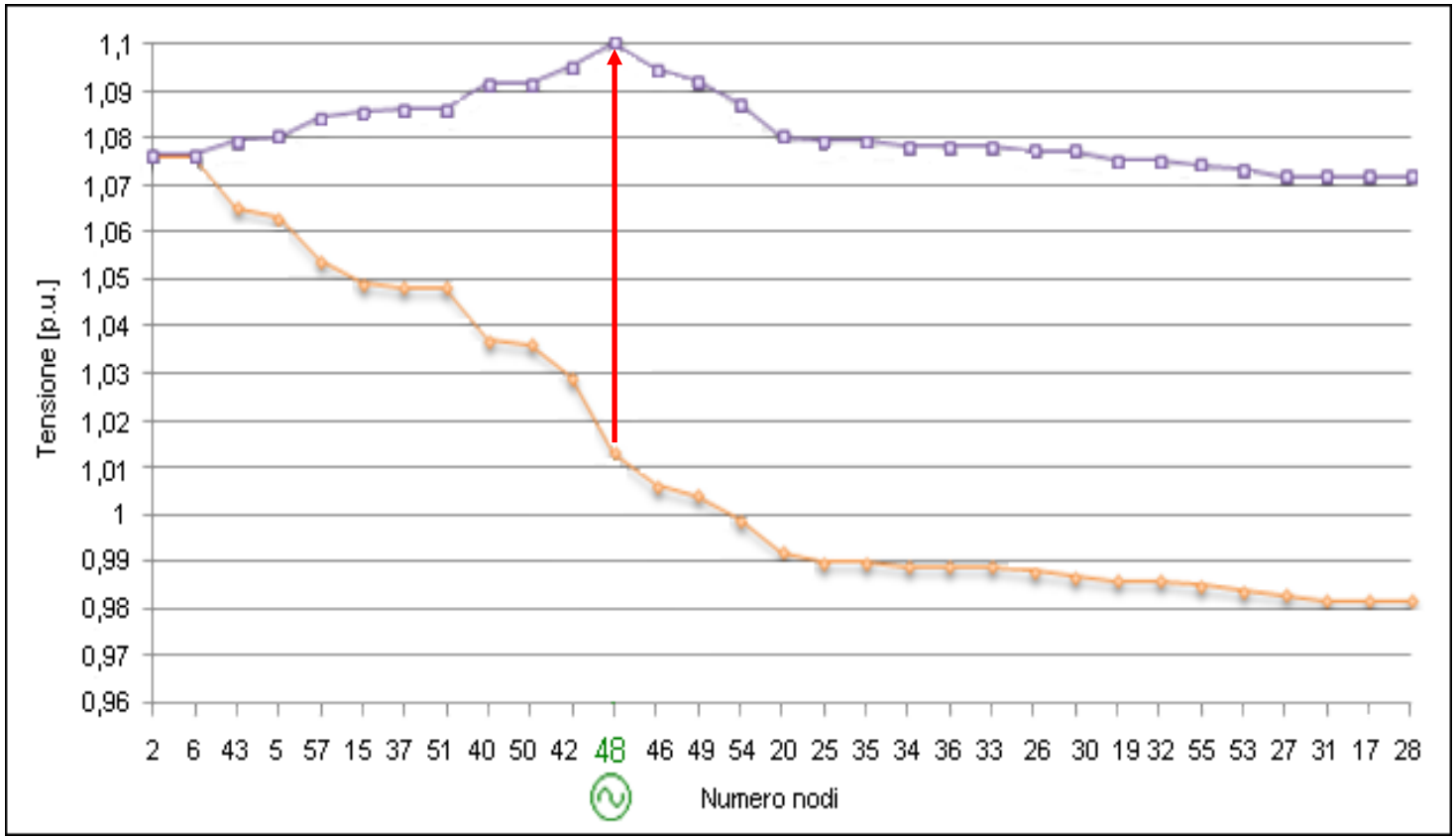
RENEWABLES HIGH PENETRATION

The effect on system operations



REVERSE FLOW TIME

% of year-time with reverse power-flow



This indicator has been used to identify critical network cases: too much DG energy injected in the network (compared with load) and therefore risk of both voltage problems and security issues (undesired inslanding).

SMART GRIDS PILOT PROJECTS

Key features

- Real grid: A real case in existing distribution networks: real grid, real customers and real generators
  - Focus on DG integration in MV networks [1-35 kV]: 75% of DG power
- Active grid: the selected MV network has to be characterized by a reverse power flow
  - At least 1% of yearly time with reverse power-flow from MV level to HV
- Automated & controlled grid: the selected MV network has to be controlled (voltage limits / anti-islanding)
  - Real time control system at MV level
- Open grid: non-proprietary communication protocols only
  - minimize customer interface costs

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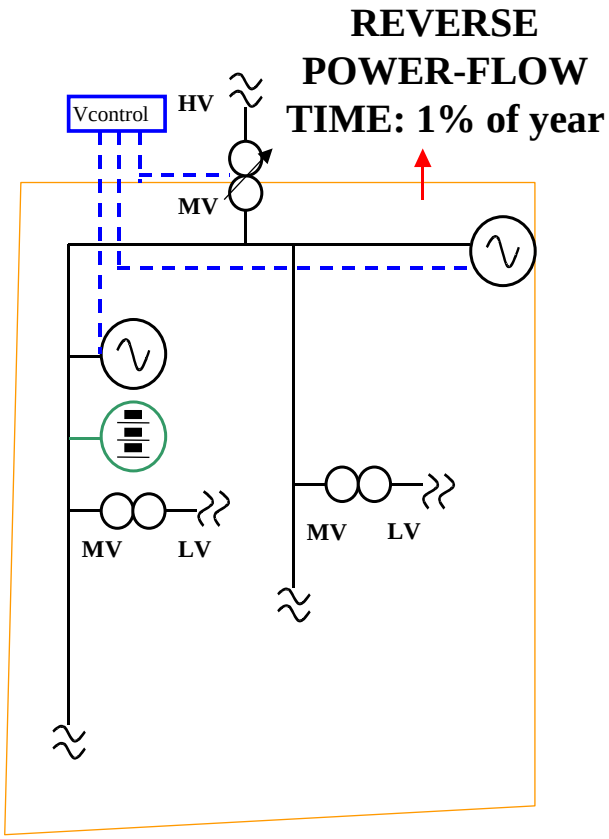
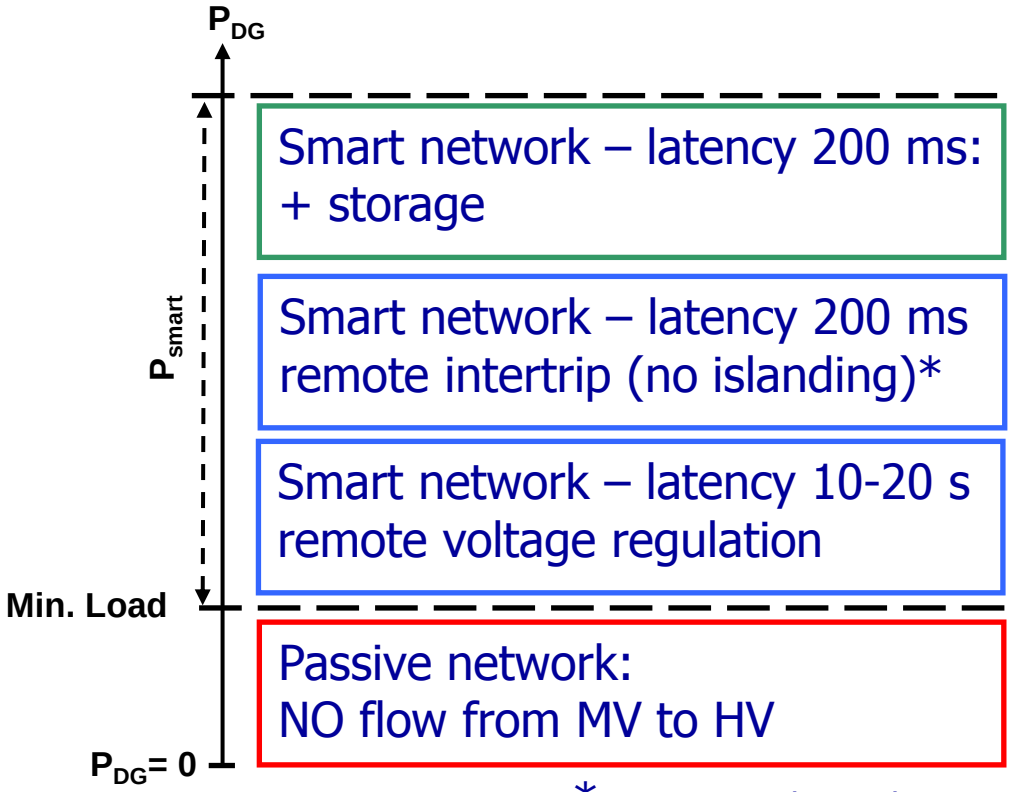
THE P-smart CONCEPT:
Hosting capacity in safe conditions





P_{smart} is the increase in DG-production (P_{DG}) that can be connected to the grid in safe conditions (voltage, currents, frequency) thanks to smart investments on the grid without reinforcing the electrical infrastructure

* *Very critical in Italy due to fast reclosure (400ms)*

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SMART GRID KEY FUNCTIONALITIES

«in safe conditions for voltage, currents and frequency»

- Power modulation: modulating active power
  - Related to Current (thermal) limits (minutes)
  - Including instantaneous curtailment for emergency
- Voltage regulation: modulating reactive power
  - Related to slow voltage variations (some tens of seconds)
- Intertrip: combined dialogue between DSO and DG in order to avoid inslanding in case of network fault
  - Related to both Frequency perturbation and fast Voltage dips (hundreds of millisec)
- Keep alive: in case ICT layer is not available, DG rolls back in old setting in order to avoid risks
  - Not related to electric parameters (every 1 second)

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KPI-APPROACH
for smart grid pilot projects evaluation (1/2)

Synthetic indicator used to assess the expected performance of the selected projects

Quantitative cost and main benefit indicator

Further benefits qualitative scoring

$$IP = \frac{P_{smart} \cdot \sum_{j=i}^{m} Aj}{C}$$

$$P_{smart} = \frac{EI_{post} - EI_{pre}}{8760}$$

IP: priority index

A_j: project benefits [point score]

C: project costs [€]

P_{smart}: increase in DG-produced electricity / hour [MW]

EI_{post}: DG-produced electricity that can be injected in the network after the project in safe conditions [GWh]

EI_{pre}: DG-produced electricity that can be injected in the network before the project without reverse flow [GWh]

BENEFIT QUALITATIVE SCORE (Σ_j Aj)
for smart grid pilot projects evaluation (2/2)

A1	SIZE	b1	N. generation plants/storage	6
		b2	Increase of electricity production injected into the grid	12
		b3	Increase of ratio "electricity production / electricity consumption"	8
		b4	N. primary substations involved in the project	4
			Max A1	**30**
A2	INNOVATION	b5	Participation of disperse generation to voltage regulation	6
		b6	Presence of control system (SCADA)	6
		b7	Bidirectional comunication and demand response	6
		b8	Presence of storage systems and active power modulation	12
		b9	Partecipation of DSO to ancillary service market	10
			Max A2	**40**
A3	FEASIBILITY	b10	Project schedule	4
		b11	Quality improvements	6
			Max A3	**10**
A4	REPLICABILITY	b12	% of costs on not regulated subjects (DG and storage)	2
		b13	Standard protocols	8
		b14	Consistency between investment costs and objectives / expected benefits of the project	10
			Max A1	**20**
			Max Project	**100**

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SELECTED SMART GRID PROJECTS (1/2)

INNOVATIVE FUNCTIONALITY	P1	P2	P3	P4	P5	P6	P7	P8
Bidirectional communication	✓	✓	✓	✓	✓	✓	✓	✓
Participation of generation plants	✓	✓	✓	✓	✓	✓	✓	✓
SCADA in PS and on field measurements	✓	✓	✓	✓	✓	✓	✓	✓
Automation of the MV grid	✓	✓	✓	✓	✓	✓	✓	✓
Participation of DSO to ancillary service market	✓	✓	✓		✓	✓	✓	✓
Presence of Storage systems				✓		✓		
Infrastructure for electrical mobility (test with DSO vehicles)		✓		✓		✓	✓	
Demand awareness (visual display)						✓		

Technical solutions of selected projects.

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SELECTED SMART GRID PROJECTS (2/2)

Position rank	Distribution Company Primary Substation (PS)	*Psmart* [MW]	Project Benefit (A_j)	Cost [k€]	Priority Index
1	**P1. A2A** PS Lambrate	53.171	65	733	4715
2	**P2. ASM Terni** PS Terni	16.176	68	800	1375
3	**P3. A2A** PS Gavardo	7701	65	755	663
4	**P4. ACEA D.** PS Roma Malagrotta	44.934	73	4.970	660
5	**P5. ASSM Tolentino** PS Tolentino	6211	66	689	595
6	**P6. ENEL D.** PS Carpinone (IS)	36.996	96	6.242	569
7	**P7. DEVAL** PS Villeneuve	12.951	68	1.616	545
8	**P8. A.S.SE.M.** PS S. Severino	3.661	64	642	365

Selected smart grid projects.

SMART GRIDS PILOT PROJECTS
(provisional) conclusions

- Demonstration projects: no only lab, real service
- Focus on critical situation: MV, high DG penetration (flow MV to HV for >1% of time)
- Requirement: open communication protocols
- Selection process, KPI approach, evaluators
- Benefits – concept of Psmart
- Process still ongoing; expected
  - Replicability on large scale
  - Regulatory learning

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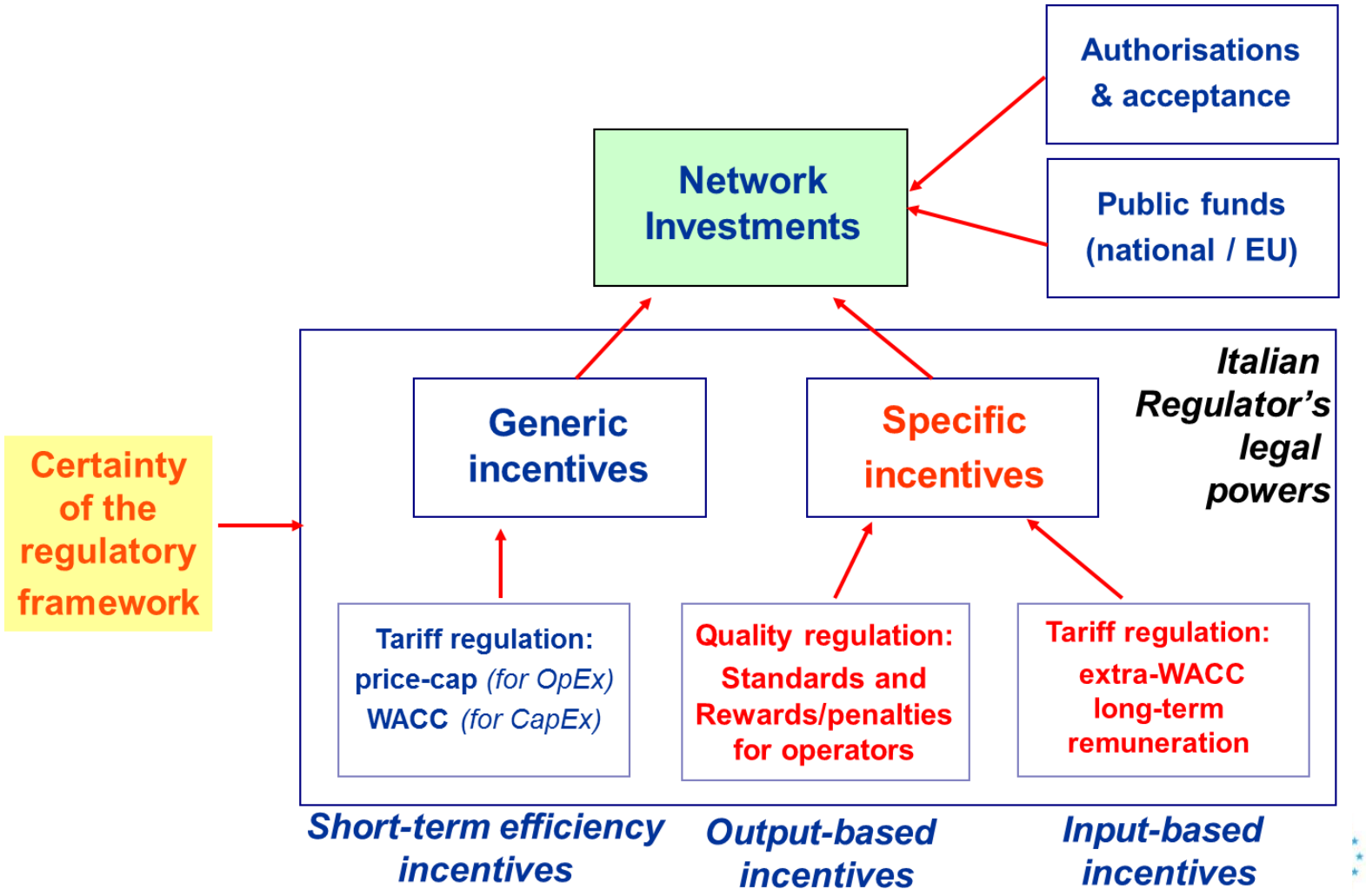
REGULATORY INCENTIVES FOR INVESTM'S

Input-based vs Output-based incentives



REGULATORY INCENTIVES FOR INVESTM'S

Input-based vs Output-based incentives in Italy

		output-based	input-based
First regulatory period 2000-2003	Priority in the Regulatory Agenda: Focus on investments for recovery of quality of supply gaps	✓ *(distrib.)*	
Second regulatory period 2004-2007	Priority in the Regulatory Agenda: Promotion of investments for security of supply (transmis.only) and quality of supply (distr.only)	✓ *(distrib.)*	✓ *(transm.)*
Third and fourth regulatory periods 2008-2011 2012-2015	Priority in the Regulatory Agenda: Promotion of strategic investments and quality of supply Transmission/distribution/metering	✓ *(distrib. +transm.)*	✓ *(distrib. +transm.)*

INPUT-BASED INCENTIVES

Remuneration of new strategic investments

Electricity networks

- Extra remuneration guaranteed up to 8-12 years for new strategic investments aimed at:
  - reducing congestion in transmission networks
  - facilitating network modernization (not quality)
  - Promoting innovation (smart grid pilot projects)
- Remuneration for new selected investment is currently between 9% -10% in real terms before taxes (regulatory period 2008-2011, updated from 2012)

Electricity networks	**WACC** (base pre-tax)	**Max Incentive**
Distribution	7 %	+2%
Transmission	6,9 %	+3%
Metering	7,2 %	

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MEASURING FOR REGULATING
Towards output-based regulation

Indicator	Type of network	Usability for project assessment	Usability for output-based regulation
Reverse Power-Flow Time	Distribution (at either network or circuit level)	Identifying critical situations due to high RES-penetration	Filter (together with DG capacity)
P-smart	Distribution (at either network or circuit level)	Measure of main smart grid benefit	Possibly an output indicator (for incentive)
Energy not withdrawn from renewables due to congestion	Distribution or Transmission	No (ex-post indicator)	Possibly a disbenefit indicator (for penalty)

First regulatory thoughts for SG deployment in Italy: DCO 34/11

Further indicators are discussed in the *CEER Smart Grid Status Review paper*

ERGEG SMART GRIDS POSITION PAPER
Final recommendations (2010)

- *Ensure* stable regulatory framework and long-term return on Investments
- *Decouple* profits and volume for grid operators
- *Introduce* output regulation: value for money of users
- *Improve* consumer awareness for energy use and market opportunities
- *Incentivise* innovative solutions (demonstration)

- *Perform* societal cost-benefit assessment
- *Disseminate* the results and lessons learned from the demonstration projects
- *Adopt* open protocols and standards for interoperability
- *Distinguish* grid- vs market-related activities
- *Learn* from best regulatory practices

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ELECTRIC VEHICLES RECHARGE
Regulatory framework in Italy

- ✓ **Private charging points – *Already settled***
  - Delivery points and dedicated meters at home
  - Transport tariff: LV other uses
- ✓ **Public recharging points –*Pilots started***
  - Transport tariff: new monomial tariff
  - Pilot projects with several business models
  - Demonstration projects can be driven *either by DNOs or service providers*
  - Not yet regulated: MV-connected fast charging

In both cases – *Integrate EVs in retail competition*

- Energy price: market

Dialogue with legislative power

- Suggestions for consideration of the Parliament

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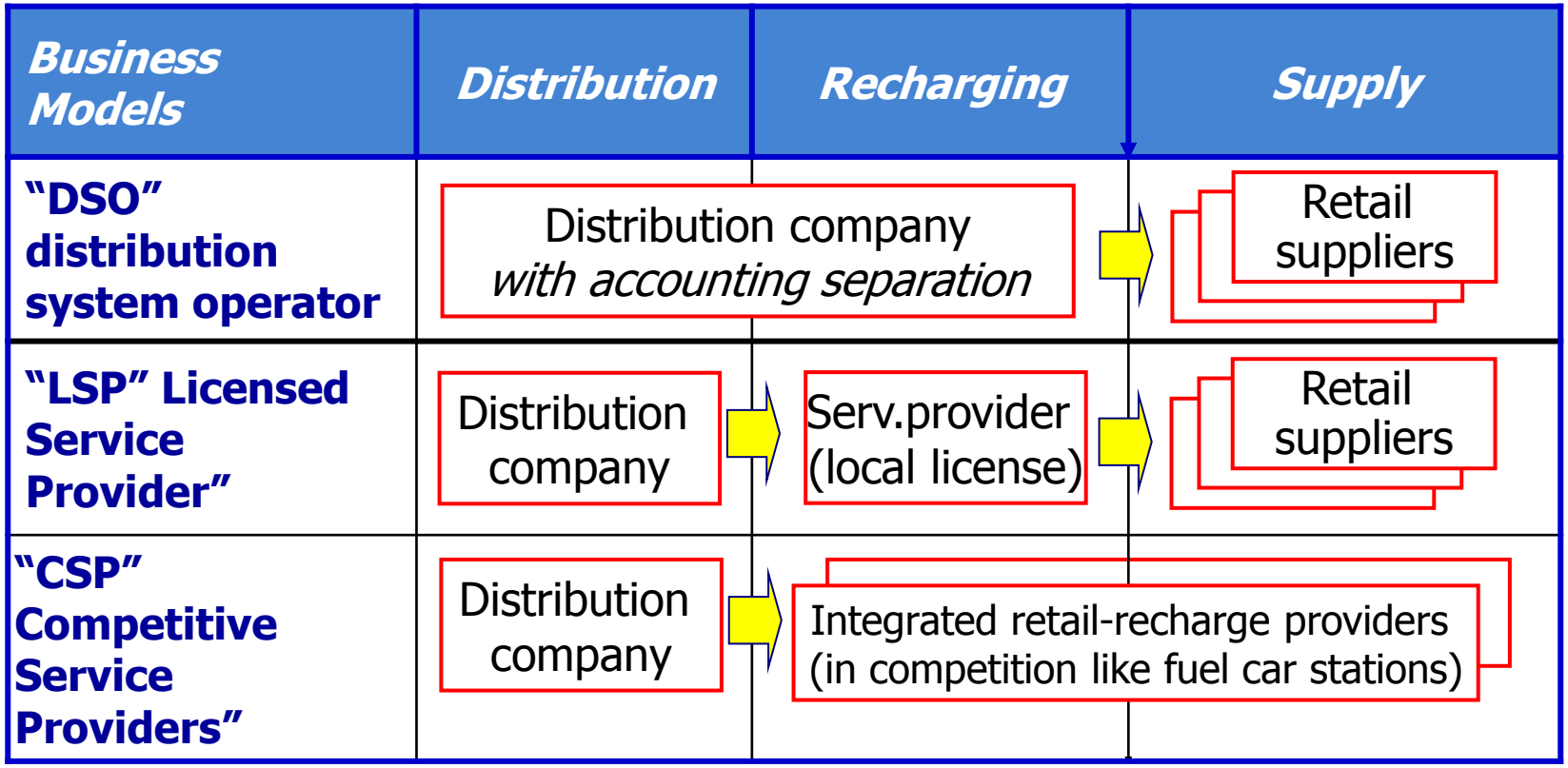
EV PUBLIC RECHARGE INFRASTRUCTURE

Three business models



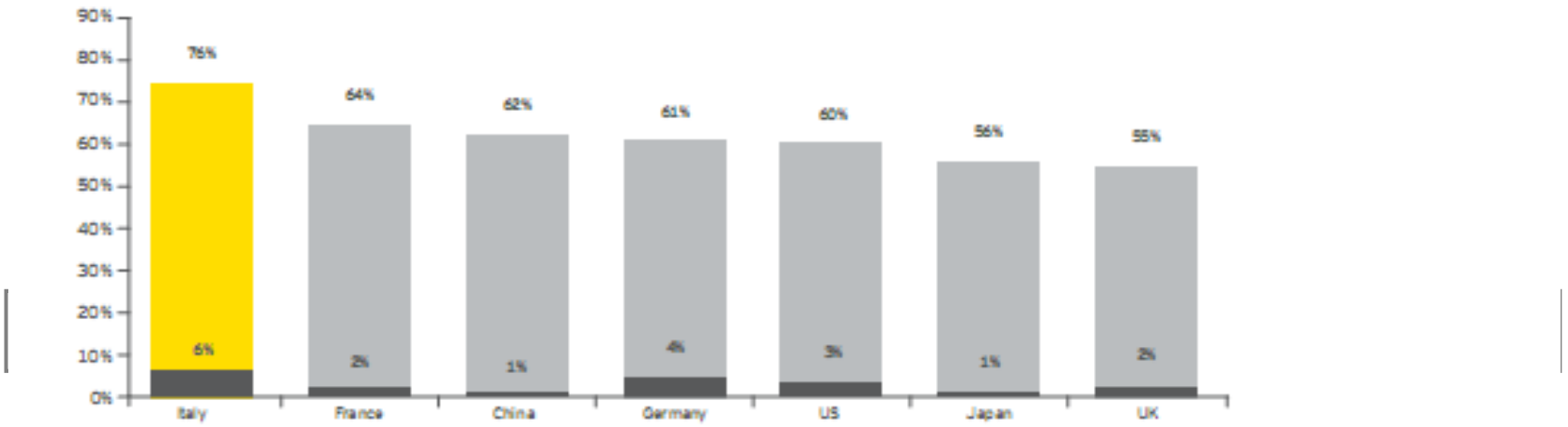
- **Multivendor** approach mandatory for DSO business model
- Both **Multivendor or Monovendor** approach allowed for service provider models (see ARG/elt 96/11 Annex A)

THE NEW MOBILE ELECTRICITY CONSUMER

The relevance of market research

Question 6

Would you consider a driving range of 100 miles to be acceptable? (Percent of respondents who answered "No")



- On average, 60% of drivers would prefer a longer driving range (above 100 miles), far longer than the average daily miles driven by respondents. (The survey demographics shows 98% drive less than 100 miles daily.)
- This result is consistent with question 5, which indicates that battery driving range is among the most significant factors for purchasing PHEVs or EVs (most important factor in Europe and China, second most important in the US and fourth most important in Japan).

Percent of respondents who drive more than 100 miles per day

Source : Ernst &Young, Gauging interest for plug-in hybrid and electric vehicles in select markets. Compared results (2010)

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PILOT PROJECTS FOR INNOVATION
A synthesis of Italian regulatory experience (1/2)

Smart grid pilot projects

- only for DSOs
- investment included in distribution RAB
- extra-WACC: +2% (12 years)
- evaluation and selection process (with help of Academics)
- quantitative and qualitative criteria – 8 project selected
- monitoring of results
- AEEG decision 39/10

EV recharging infrastructure pilot projects

- not only for DSOs: also SPs
- investment not included in distribution RAB
- remuneration: 728 euro/point/year (minus applicant's discount)
- evaluation and selection process
- mainly qualitative criteria – 5 project selected (1 or 2 per business model)
- monitoring of results
- AEEG decision 96/11

PILOT PROJECTS FOR INNOVATION
A synthesis of Italian regulatory experience (2/2)

OUTPUT-BASED

- *e.g.* **Quality of Supply**
- **Reliable and fair metrics:**
key outcome indicators that must be cleansed from out-of-control effects; authoritative and enforceable guidance for data recording and auditing
- **Baseline**
(natural improvement trend): output based incentive should be related only to additional improvements on top of natural improvement trend (historically observable)
- **Output valuation**
value of outcome should be assessed taking into consideration both customers view and societal welfare (CEER 2011 report compares VoLL values)

INPUT-BASED

- *e.g.* **Innovation**
- **Metrics not yet fully available**
however, regulator's need for simple cost/benefit ratios, in order to avoid "lenghty proceedings"
- **Demonstration projects**
"real networks, real voltages, real currents, real bills"; selection indexes for identifying critical network areas
- **Incentive as Delta-WACC**
+2% for 12 years on top of ordinary WACC
- **Learning process**
evaluation and selection process, monitoring performance and dissemination of results; evolution in output-based regulation

Please visit:

www.autorita.energia.it

www.energy-regulators.eu

Suggested reading

CHANGING THE REGULATION FOR REGULATING THE CHANGE
Innovation-driven regulatory developments in Italy
ICER Distinguished regulatory scholar Award 2012
http://www.iern.net/portal/page/portal/IERN_HOME/ICER_HOME/ABOUT_ICER/Distinguished_Scholar_Award_2012

Thank you for your attention

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