Policies for Motor Systems

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Paolo Bertoldi

European Commission DG JRC

Classification of barriers to energy efficiency (based on Sorrell et al., 2000).

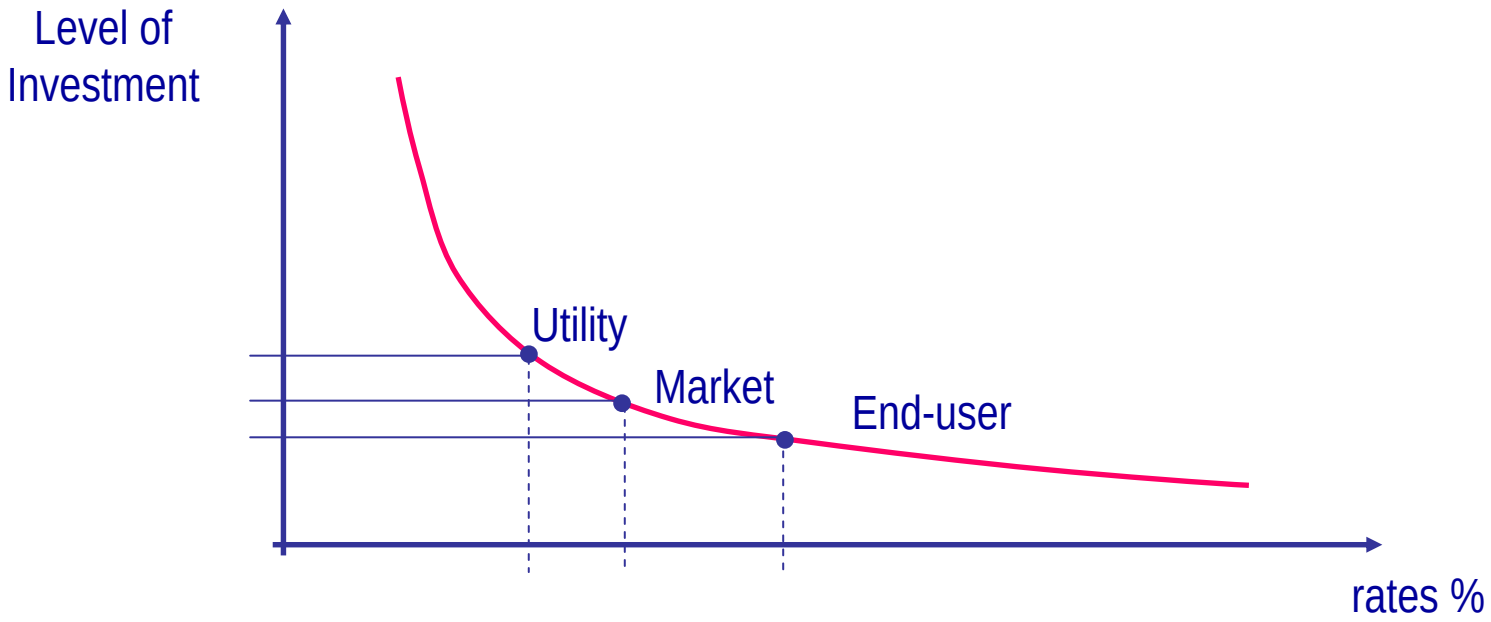
Theoretical Barriers	Comment
Imperfect information (Howarth and Andersson, 1993)	Lack of information may lead to cost-effective energy efficiency measures opportunities being missed.
Adverse selection (Jaffe and Stavins, 1994)	If suppliers know more about the energy performance of goods than purchasers, the purchasers may select goods on the basis of visible aspects such as price.
Principal-agent relationships (Jaffe and Stavins, 1994)	Strict monitoring and control by the principal, since he or she cannot see what the agent is doing, may result in energy efficiency measures being ignored.
Split incentives (Jaffe and Stavins, 1994)	If a person or department cannot gain benefits from energy efficiency investment it is likely that implementation will be of less interest.
Hidden costs (Jaffe and Stavins, 1994)	Examples of hidden costs are overhead costs, cost of collecting and analyzing information, production disruptions, inconvenience etc..
Access to capital (Jaffe and Stavins, 1994)	Limited access to capital may prevent energy efficiency measures from being implemented.
Risk (Jaffe and Stavins, 1994)	Risk aversion may be the reason why energy efficiency measures are constrained by short pay-back criteria.
Heterogeneity (Jaffe and Stavins, 1994)	A technology or measure may be cost-effective in general, but not in all cases.
Form of information (Stern and Aronsson, 1984)	Research has shown that the form of information is critical. Information should be specific, vivid, simple, and personal to increase its chances of being accepted.
Credibility and trust (Stern and Aronsson, 1984)	The information source should be credible and trustworthy in order to successfully deliver information regarding energy efficiency measures. If these factors are lacking this will result in inefficient choices.
Values (Stern, 1992)	Efficiency improvements are most likely to be successful if there are individuals with real ambition, preferably represented by a key individual within top management.
Inertia (Stern and Aronsson, 1984)	Individuals who are opponents to change within an organization may result in overlooking energy efficiency measures that are cost-effective.
Bounded rationality (DeCanio, 1993)	Instead of being based on perfect information, decisions are made by rule of thumb.
Power (Sorrell et al., 2000)	Low status of energy management may lead to lower priority of energy issues within organizations.
Culture (Sorrell et al., 2000)	Organizations may encourage energy efficiency investments by developing a culture characterized by environmental values.

The End-user Perception

- It is difficult to have clear and meaningful information on energy performances
- The energy prices fluctuate and they will alter the yield of the investment
- The investments are non easy to re-sell
- **This for the average end-user increases the perceived risk**

Barriers to energy efficiency

"… The end-users tend to discount energy efficiency investments with rates higher than the market average."



As rates increase the willigness to investments decreases

Barriers to Energy Efficiency

Economic barriers:

Market failure barriers:

- "Split incentives": benefits and investment costs are related to different subject
- Lack of good information (lack of technical understanding and expertise)

Non-market failure barriers:

- Hidden costs
- Access to capital
- Perception of risk

Behavioural barriers

- Technical requirements/characteristic of equipment and reluctance to change what works

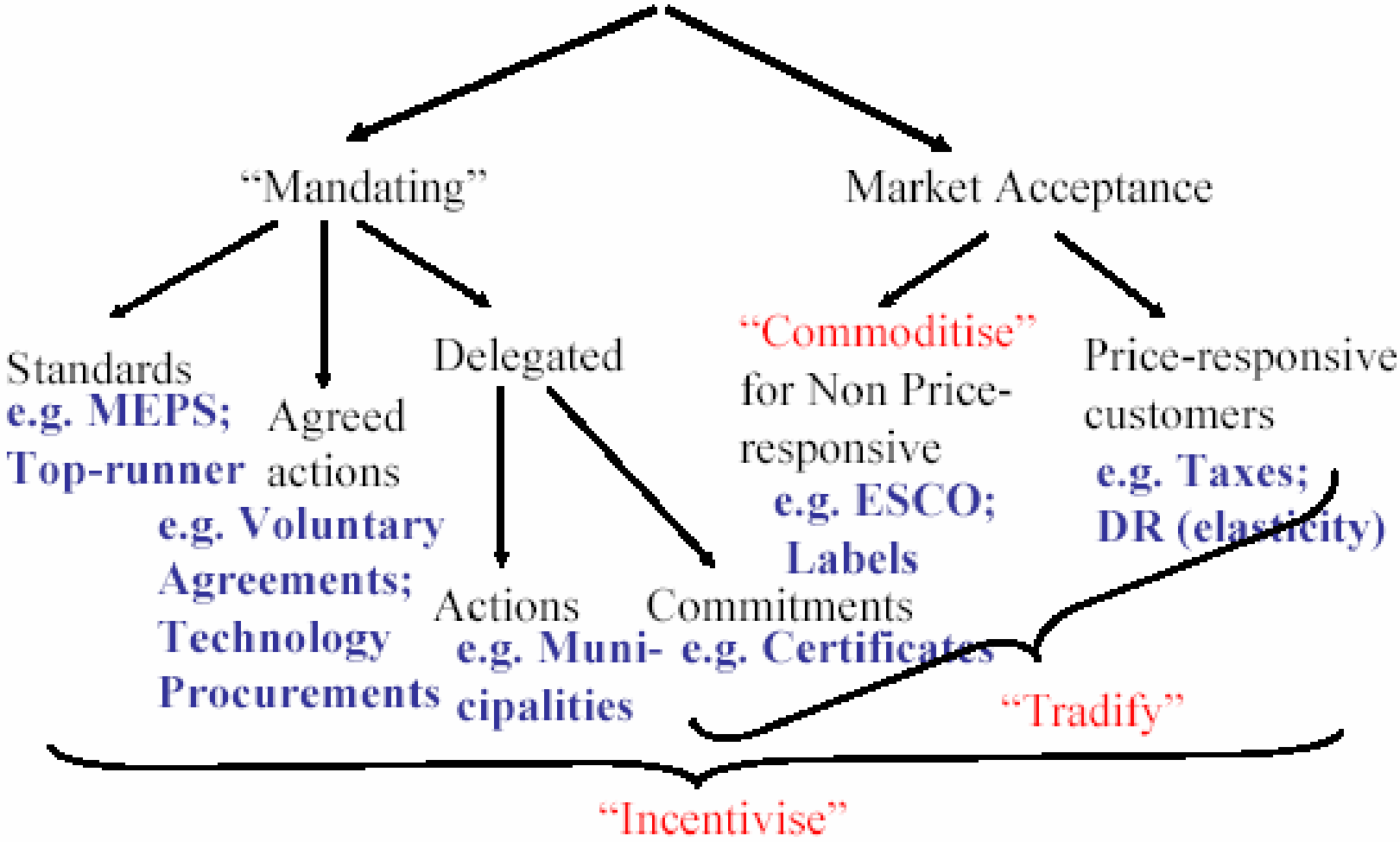
Eliminates or reduce the barriers:

- Reduce the risk perceived by the end-user
- Raise the end-user awareness and increase the chances of implementation
- Bundle together the costs and benefits
- Create and foster the energy efficiency and energy services offer and market

Policies for the Promotion of Energy Efficiency

- Minimum efficiency requirements for end-use equipment and buildings
- Incentives for investments in energy efficiency
- Information tools and labelling
- Provision of energy services (ESCOs)
- Energy Audits
- Voluntary programmes
- Public benefits charges, energy efficiency obligations (white certificates) and DSM programmes

LARGE-SCALE ENERGY EFFICIENCY



Minimum Efficiency Requirements

- Very powerful policy to phase out least efficient products from market;
- Mandatory minimum efficiency requirements (MEPS) have been applied to motors itself (standard motor for industrial applications, i.e. the 3-phase induction motors) in many countries (US, Canada, Australia, China, Korea, New Zealand, Mexico, Brazil, Israel);
- Other countries/regions are considering adopting MEPS (the EU, Thailand, Vietnam);
- Some countries have implemented voluntary standards
- Key issues are the existence of test methods, and enforcement procedures;
- Only some countries have adopted or are considering adopting MEPS for other motor system components (fans, pumps, etc.)
- MEPS must be dynamic and follow market transformation and be regularly updated.

Why Information?

- **The cost of researching and acquiring information is for many too high.**
- **The truly independent information is rarely available**

Labelling and Classification Schemes

- MEPS have been often accompanied by information schemes to try to inform and persuade end-user to make the most "rational" choice, e.g. based on LCC or Net Present Value.
- The information scheme range from simple labelling of motors such as the European EFF classification, or the new new IEC 60034-30 Ed. 1 "Efficiency Classes of single-speed three-phase cage induction motors (IE code)" to quality marks to highlight the most efficient motors such as the US NEMA Premium Motor,
- and finally to more sophisticated information and selection tools such as the databases and software Motor Master in the US and EuroDEEM in the EU, or the more recent international effort IMSSA

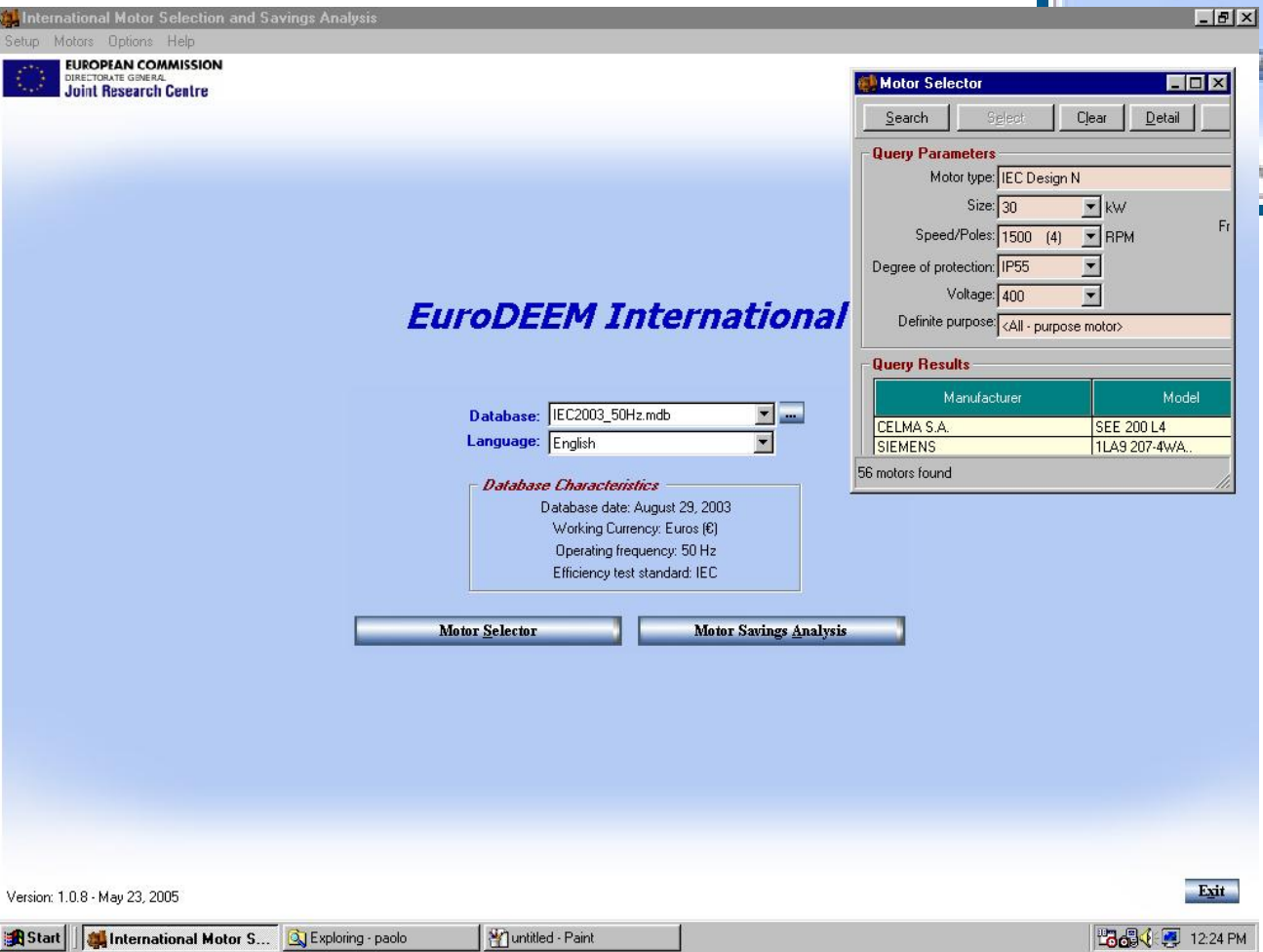
Databases and Software

More sophisticated information and selection tools exist

- the database and software Motor Master + in the US (An energy-efficient motor selection and management tool, MotorMaster+ software includes a catalogue of over 20,000 AC motors. This tool features motor inventory management tools, maintenance log tracking, efficiency analysis, savings evaluation, energy accounting, and environmental reporting capabilities) and
- EuroDEEM in the EU,
- The international IMSSA can evaluate repair/replacement options on a broader range of motors, and conduct analyses in different currencies, calculate efficiency benefits for utility rate schedules with demand charges, edit and modify motor rewind efficiency loss defaults, and determine "best available" motors.

JRC
EUROPEAN COMMISSION

IMSSA



Labelling of Pumps and Fans (1)

- In principle MEPS, classification, quality mark, and incentives could be also be useful for other types of motor system equipment such as pumps, fans, compressors.
- However due to the different type of applications, and different metric to assess performance, MEPS and labelling for pumps and fans are rather complicated.
- In the EU for water pumps, the procurement lines have been recently introduced as a dynamic classification scheme to calculate the efficiency of different pumps at a given operating point. More recently under the EuP studies and legislative proposals have been developed for the labelling and classification of (water) pumps and funs.

Labelling of Pumps and Fans (2)

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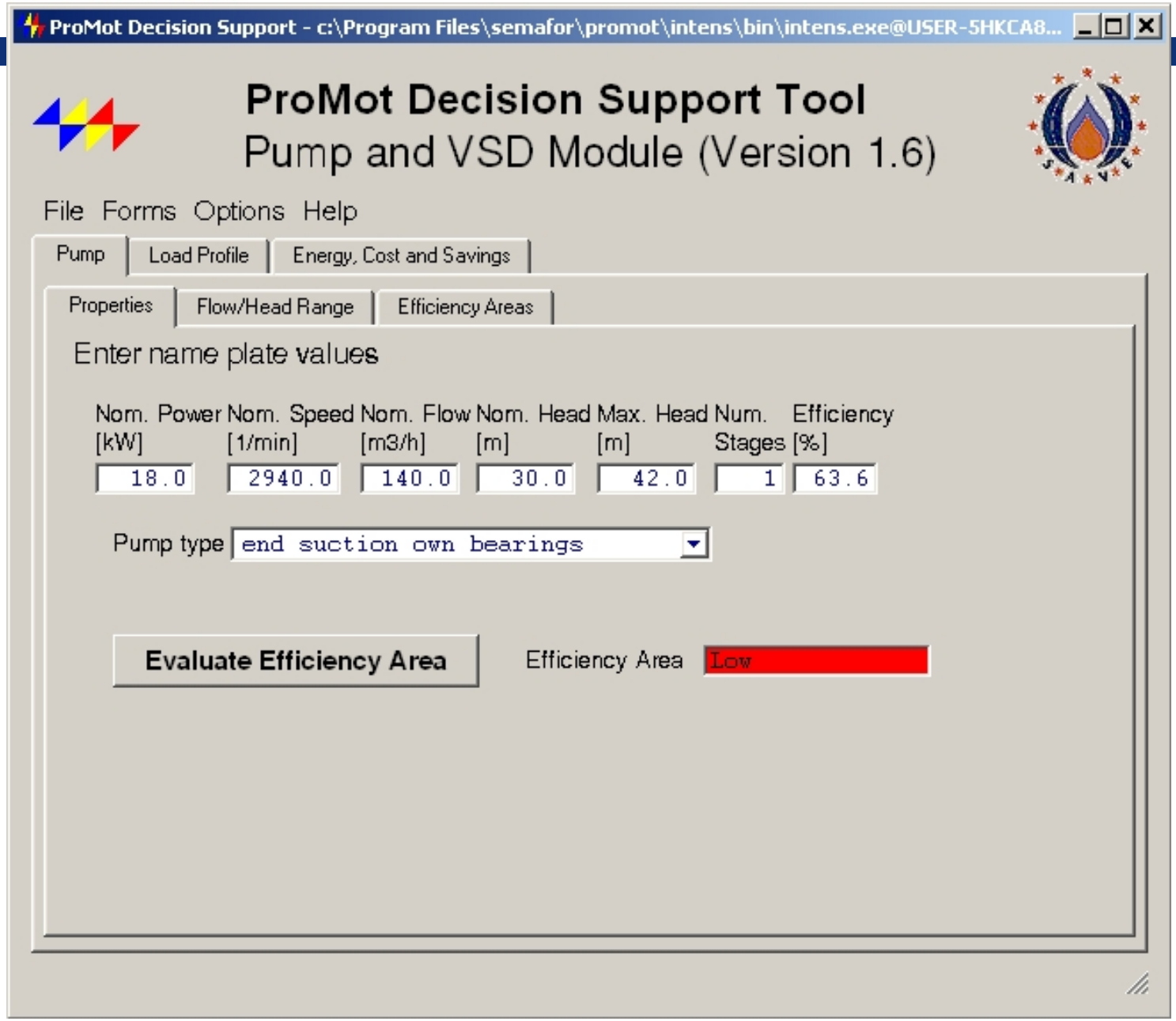
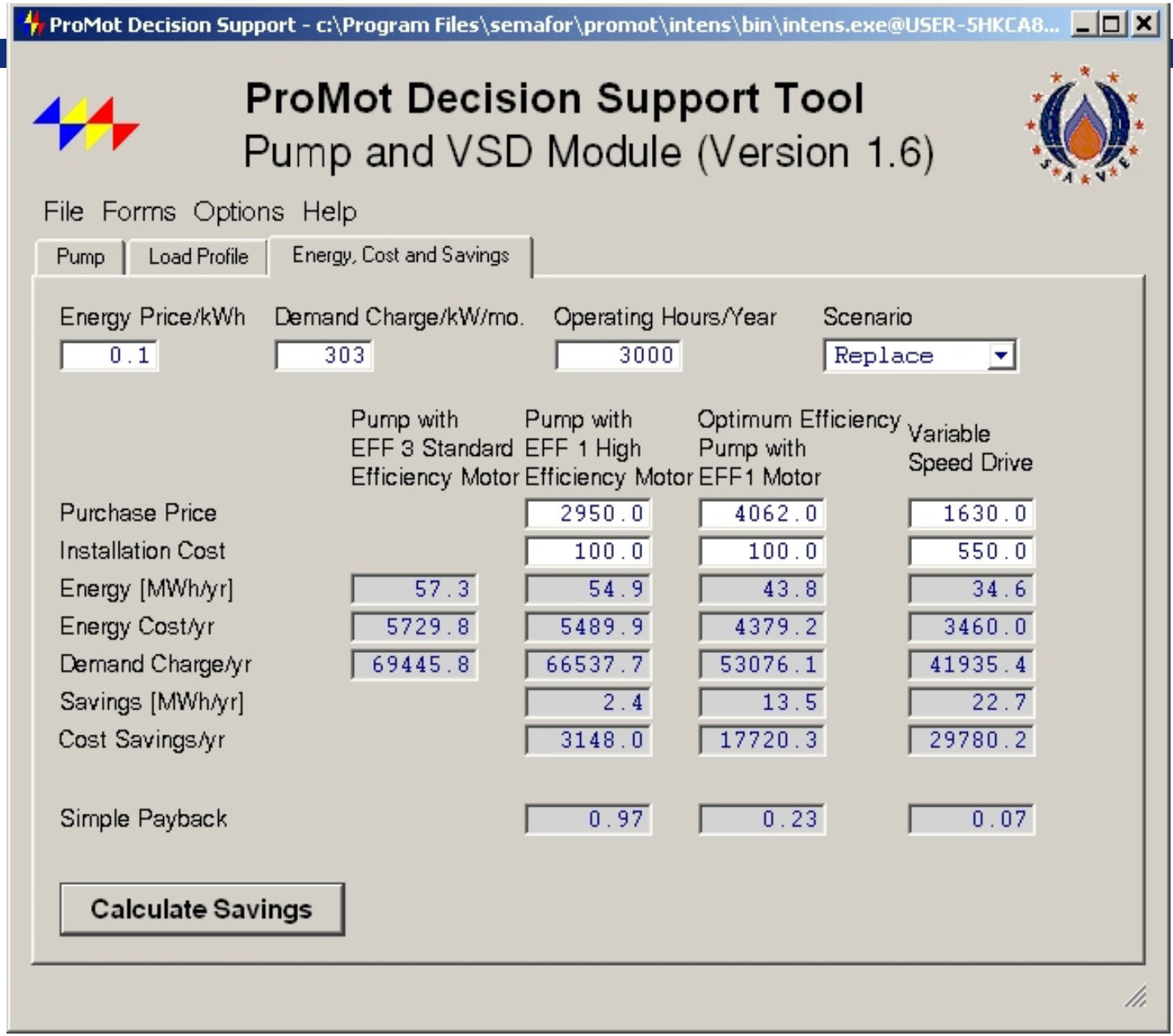

ProMot Decision Support - c:\Program Files\semafor\promot\intens\bin\intens.exe@USER-5HKCA8...
ProMot Decision Support Tool
Pump and VSD Module (Version 1.6)
File Forms Options Help
Pump
Load Profile
Energy, Cost and Savings
Properties
Flow/Head Range
Efficiency Areas
Enter name plate values
Nom. Power [kW]
Nom. Speed [1/min]
Nom. Flow [m3/h]
Nom. Head [m]
Max. Head [m]
Num. Stages
Efficiency [%]
18.0
2940.0
140.0
30.0
42.0
1
63.6
Pump type
end suction own bearings
Evaluate Efficiency Area
Efficiency Area
Low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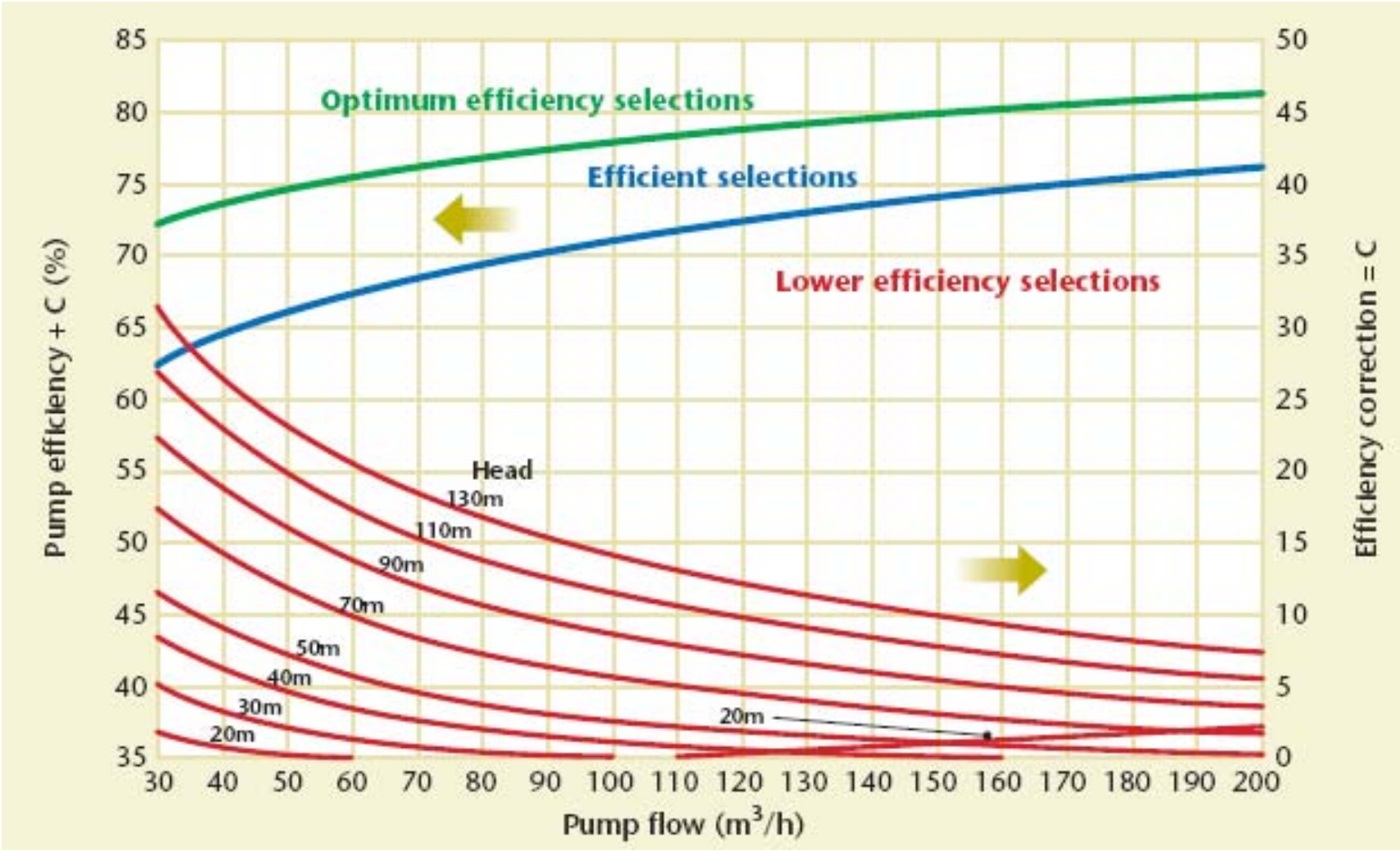
Pump
Load Profile
Energy, Cost and Savings
Energy Price/kWh
0.1
Demand Charge/kW/mo.
303
Operating Hours/Year
3000
Scenario
Replace
Pump with EFF 3 Standard Efficiency Motor
Pump with EFF 1 High Efficiency Motor
Optimum Efficiency Pump with EFF1 Motor
Variable Speed Drive
Purchase Price
2950.0
4062.0
1630.0
Installation Cost
100.0
100.0
550.0
Energy [MWh/yr]
57.3
54.9
43.8
34.6
Energy Cost/yr
5729.8
5489.9
4379.2
3460.0
Demand Charge/yr
69445.8
66537.7
53076.1
41935.4
Savings [MWh/yr]
2.4
13.5
22.7
Cost Savings/yr
3148.0
17720.3
29780.2
Simple Payback
0.97
0.23
0.07
Calculate Savings

US DoE Assessment Tools

- Fan System Assessment Tool (FSAT) to help quantify the potential benefits of optimizing fan system configurations that serve industrial processes.
- AIRMaster+ provides comprehensive information on assessing compressed air systems, including modelling, existing and
- Pumping System Assessment Tool (PSAT) helps industrial users assess the efficiency of pumping system operations. This version of the tool and its accompanying valve tool support data measurements in either English or metric units.


Optimum efficiency selections
Efficient selections
Lower efficiency selections
Head
130m
110m
90m
70m
50m
40m
30m
20m
20m
Pump efficiency + C (%)
Efficiency correction = C
Pump flow (m³/h)
85
80
75
70
65
60
55
50
45
40
35
50
45
40
35
30
25
20
15
10
5
0
30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

Why Incentives ?

- Incentives are a way to transfer to end-user the social value of energy savings. This social value is not included in the cost of the saved energy

- These financial incentives have proven to be very effective especially targeting very high levels of efficiency, and when the initial market share of these high efficiency models is very low.

Which Types of Incentives ?

- Loans
- Discount and Rebates
- Direct installation
- Tax incentives (Italy 20% for motors, UK Enhanced Capital Allowance Scheme that provides 100% first year capital allowances for specified energy efficiency investments)
- Carbon financing (e.g. CDMs)

Experiences Teaches That ….

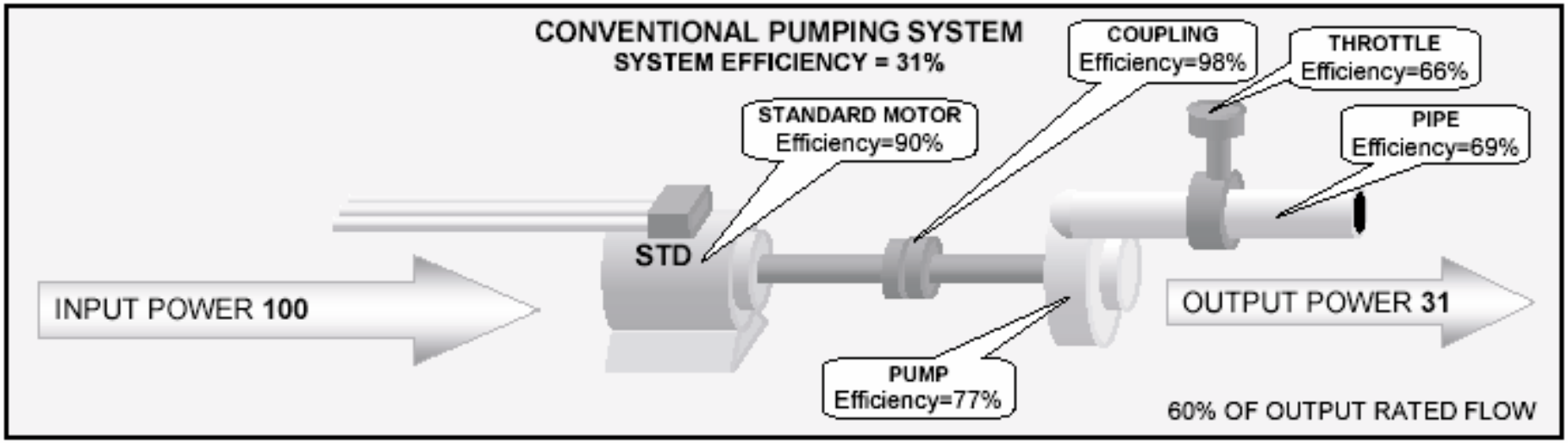
- Incentives have a large economic impact. They are very effective in stimulating participation, but usually education has a better cost/benefit ratio.

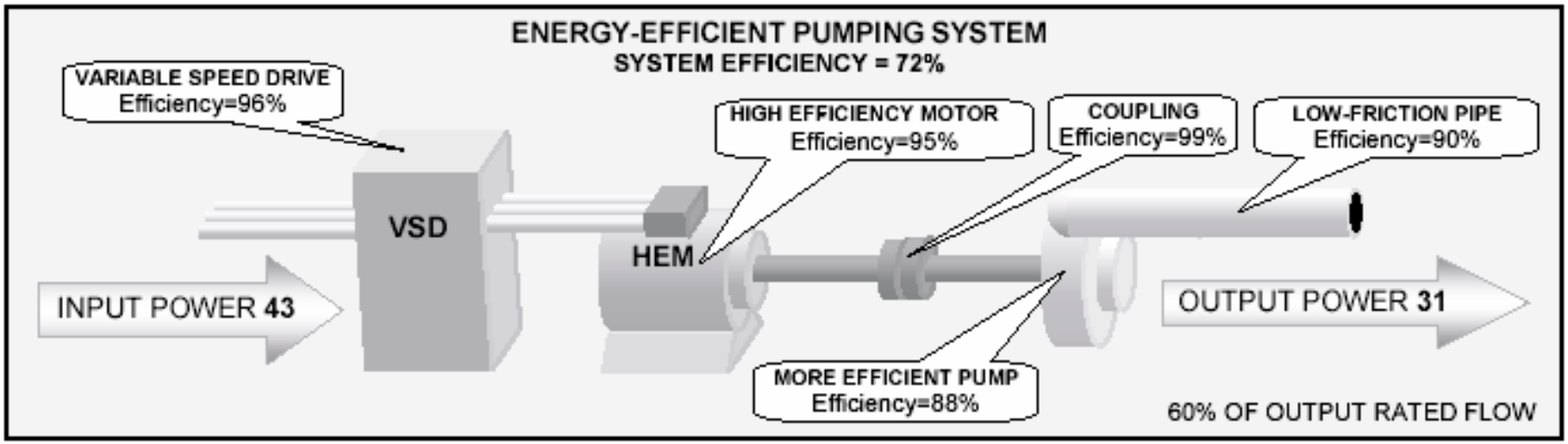
- Incentives alone do not assure the success, the degree of participation vary a lot. Incentives shall always be accompanies by an information campaign.

- Incentives shall be added on to already existing activities and policy initiatives.

- The size of the intervention shall be valued before launching incentives that force the substitution.

- As already indicated most of the savings are in the system optimisation, and for these there are a number of policies planned and adopted, and this is an area of increasing interest for policy makers.


CONVENTIONAL PUMPING SYSTEM
SYSTEM EFFICIENCY = 31%
COUPLING
Efficiency=98%
THROTTLE
Efficiency=66%
STANDARD MOTOR
Efficiency=90%
PIPE
Efficiency=69%
STD
INPUT POWER 100
OUTPUT POWER 31
PUMP
Efficiency=77%
60% OF OUTPUT RATED FLOW


ENERGY-EFFICIENT PUMPING SYSTEM
SYSTEM EFFICIENCY = 72%
VARIABLE SPEED DRIVE
Efficiency=96%
HIGH EFFICIENCY MOTOR
Efficiency=95%
COUPLING
Efficiency=99%
LOW-FRICTION PIPE
Efficiency=90%
VSD
HEM
INPUT POWER 43
OUTPUT POWER 31
MORE EFFICIENT PUMP
Efficiency=88%
60% OF OUTPUT RATED FLOW

Energy Management

- Energy management is a company decision to look at energy efficiency in a strategic manner as they do for the quality management.
- Energy management is based on the Plan-Do-Check-Act approach but includes assigning to energy efficiency a priority in the company, to appoint an energy efficiency manager, and finally adopting a number of companies policies such as to buy equipment based on LCC, to have regular monitoring of energy consumption, to have a budget for energy efficiency investments (energy efficiency can thus become a profit centre in the company).
- Often the maintenance engineer have not a strong voice in the company and a limited budget, which is separate from the operating budget, so any economic benefit they generate is not visible in the company.
- Energy management has been introduced in some European MSs (Sweden, Ireland, and Denmark) part of voluntary programmes, recently CEN set up a working group to write a European Energy Management Standard, which is now completed.
- Also ISO has recently started activities in this area.

Audits

- One of the first steps in analysing motor system is to run an energy audit.
- Audit could be a simple walk through to a more detailed investment graded audit.
- Audits are a first eye opener for end-user, especially if they give important recommendations on possible option to improve efficiency and save energy.
- Policies to promote audits include free or subsidised audits (e.g. France) or mandatory audits (e.g. Czech Republic).
- Some time audits are part of voluntary agreement between companies and the government (called also covenants or Long Terms Agreements), this is the case in Finland and the Netherlands.

ESCOs

- Audits however are not enough to assure that the potential energy saving measures are implemented, especially if there is no budget to invest in energy efficiency options, nor expertise, nor trust in the audit results.
- To this end a great role in the implementation of the measures identified by the audit could come from the Energy Saving Companies (or ESCOs).
- ESCOs take the risk associated with any energy efficiency project away from the final user
- The ESCO could also provide the free audit, prepare a project to improve energy efficiency, invest in the energy efficiency measure and get repaid at a later stage from the energy savings, and/or provide a guarantee of the energy savings, and finally operate the system under optimal conditions.
- ESCOs are the ideal solution for companies not having the technical expertise, or the time, or the financial resources to invest in energy efficiency.
- ESCOs still need in most countries policy support as it is a new industry and their offer and services is not yet understood and trusted by the final users.
- Recently a number of utilities and product suppliers have introduce an ESCO type offers/services to win new customers or to retain others.

Introduction to Voluntary Programmes

- **Energy efficiency** is a key components of any organisation to reduce environmental impact, and increase competitiveness through a reduction of energy costs;
- **Voluntary programmes** based on shared goals between the public administration and organisation have proven to work (e.g. US Energy Star programme);
- **Benefits** for the programme **participants** are: access to information, (technical) support for their energy efficiency actions, dissemination of their achievements, awards;
- **Benefits** for the **public administration**: achievement of energy saving by deploying market forces and information, without strong intervention as in the case of regulation, shared goals with private sector;

The European Motor Challenge Programme

- A voluntary initiative of the European Commission to aid industry in reducing electricity consumption in motor driven systems.
- Promotion of Variable Speed Drives
- Support: tool box, software, documents…

An initiative by the European Commission

Policy Mechanisms for EE-DSM

- Dedicated Funds for EE-DSM created from non-by-passable levy or tax (e.g., DK, NL)
- Tariff-Making Mechanisms for monopoly segments: (A) specific to EE-DSM; (B) choose a tariff-making scheme avoiding artificial incentives to increase sales (e.g., IT, UK, DK)
- Energy Efficiency Targets set via obligations (mainly US) or negotiated agreements (e.g., UK, DK, IT, BE, FR)
- Other Legal and Technical Supports (e.g., Berlin)

Tradable Certificates for Energy Savings (White Certificates)

Introduction

- Market-based instruments (MBIs) are public policies which make use of market mechanisms with transferable property rights to distribute the burden of a public policy.

- In the energy sector MBIs have been used to promote RES-E and to cut harmful emissions (e.g. CO_2, SO_2, No_x quotas coupled with permit/allowance trading).

- Theoretically MBIs minimize cost for society for reaching a certain target (static efficiency) and create incentives to innovate and improve performance (dynamic efficiency).

Liberalization and EE

- A possible market-based policy portfolio oriented towards end-use energy efficiency could comprise **energy-savings quota** for some category of operators (distributors, suppliers, consumers, etc.).
- The quota is achieved by **saving** associated to energy efficiency **projects**.
- The savings would be verified by the regulator and **certified by means of the so-called "white" certificates** (tradable certificates for energy savings);
- The savings or the certificates or the quota could be **traded**;

Key features

Five key elements of Tradable Efficiency Certificates schemes:

- the creation and framing of the demand (government set the overall target and its apportioning).
- the tradable instrument (certificate) and the rules for issuing and trading,
- Institutional infrastructure and processes (such as measurement and verification) to support the scheme.
- the cost recovery mechanism, in some cases.
- A system of sanctions in the case of non compliance

European TEC Schemes

- **Great Britain** has a variation of this policy mix scheme since 2002, without trading;

- Tradable certificates have been introduced in **Italy** (in 2005), and since July 2006, in **France**.

- *Poland* has announced in its NEEAP the implementation of a white certificate system in 2009. In *Flanders* (region of Belgium) and in *Ireland* there are savings obligations imposed on electricity distributors without certificate trading option; saving obligations on electricity, gas and heat distributors in *Denmark*.

Overview of European industrial energy efficiency policy instruments

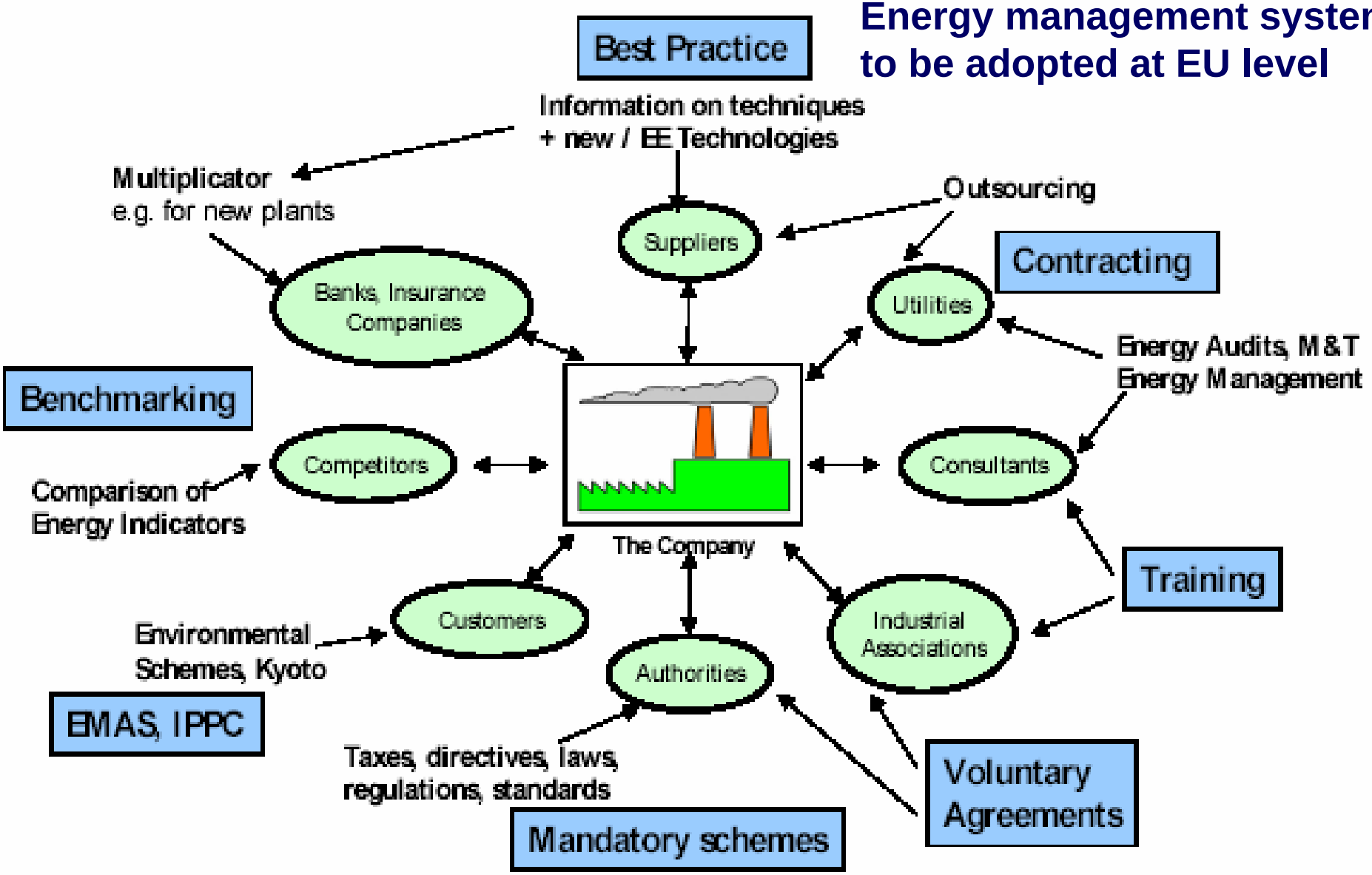
- Energy management (CEN, EMAS);
- Agreements (Negotiated, Voluntary, Unilateral, Long Term);
- Energy Audits;
- IPPC Directive:
  - Energy Efficiency BREF finalised.
  - Article 3 says: “Member States shall take the necessary measures to provide that the competent authorities ensure that installations are operated in such a way that energy is used efficiently;”
- Benchmarking and best practice (and specific programmes)
- ESCOs
- Taxation
- Financial incentives and White Certificates
- Emission Trading

A cost-effective strategy

In general:

- A combination of different measures
  - (normative, economic, labelling, consulting, agreements, information, R&D, organisation, etc.)
- A combination of different actors
  - (EU, national governments, regional and local authorities, energy utilities, producers, green organisations, etc.)
- A combination of different target groups
  - (consumers, producers, installers, developers, etc.)

Policies for the industrial sector



Thank you!

We welcome comments

For more information!

Paolo.Bertoldi@ec.europa.eu

http://re.jrc.ec.europa.eu/energyefficiency

Definitions

- Programme:
  a combination of information and incentives which is not directly paid by the customer or market actor who benefits, e.g.: free audits, rebates, procurement, education and training

- Service:

  a combination of information and incentives which is directly paid by the customer or market actor who benefits, e.g.: paid audits, third party financing, leasing, renting

- Legislation/Regulation:
  Other legal or regulatory actions targeted to customers or technology suppliers, e.g.: mandatory labelling, minimum efficiency standards, technical performance standards

Which action for which potential?

- "masses of standard units" potentials, e.g.,
  CFLs, A-class fridges, standby; HEMs, VSDs, HF ballasts:
  too small/too high transaction costs for services;
  synergies between legislation and programmes

- "large complex project" potentials, e.g.,
  compressed air, cooling plants; large ventilation or lighting retrofits: this is the market for energy efficiency services!

Energy Management Standard

TF 189/PT "Energy Management Systems", has developed during 2007 the draft Standard, delivered at the end of 2007 to CEN and CENELEC for the public enquiry, which took place in the first half of 2008.

The draft pr EN 16001 "Energy Management System with Guidance for use" has been accepted by all the European NSB, except one, with many comments and modifications asked.

TF 189/PT EMS has consequently revised the draft, and the final text is being delivered to CEN and CENELEC for the final vote, before the end of this year.

Pubblication of EN 16001 is therefore expected by mid 2009.

The EN 16001 is based on the combination
of the three existing national Standards:

- Danish: DS 2403 E (2001) + DS/INF 136 E (2001);
- Swedish: SS 62 77 50 (2003);
- Irish: I.S. 393 (2005);
- plus the Dutch and German Specifications.

- It includes a "Guidance for use".
- It is fully consistent with ISO 9001-2000 and ISO 14 001