NORWEGIAN PETROLEUM DIRECTORATE

Master the uncertainties of novel technology in field developments

"Approval and acceptance from the authorities. Novel technology- safety, environment and economy"

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Comment to the title

- The NPD does not formally *approve* nor *accept* any type of technology as such

- Evaluation of novel technology is one part of the total evaluations of new field developments

- NPD-mandate
  - Evaluate new field developments (PDO)
  - Recommend for approval if
    -Socio economic best solution
    -Within expected safety level
    -Best available technology used for minimum environmental impact

Why encourage dev. of novel technology?

- Continuously improve the HSE level in the industry
- Increase the socio economic value creation
  - Obtain recovery objectives
  - Become more cost efficient
- Meet challenges in future field developments
  - Smaller fields
  - Deeper waters
  - HPHT
  - :
- Fulfil national environmental commitments

The authorities- measures

- Incentives in taxation structure
- Systematic adjustments in regulations allowing increased flexibility
- Open door policy wrt discussions of novel technology (NPD attitude, interpretation of regulations…)
- Participation/initiatives in national campaigns (Demo2000, OG21,…)
- Financial support to R&D (The Research Council of Norway)

Incentives in taxation structure

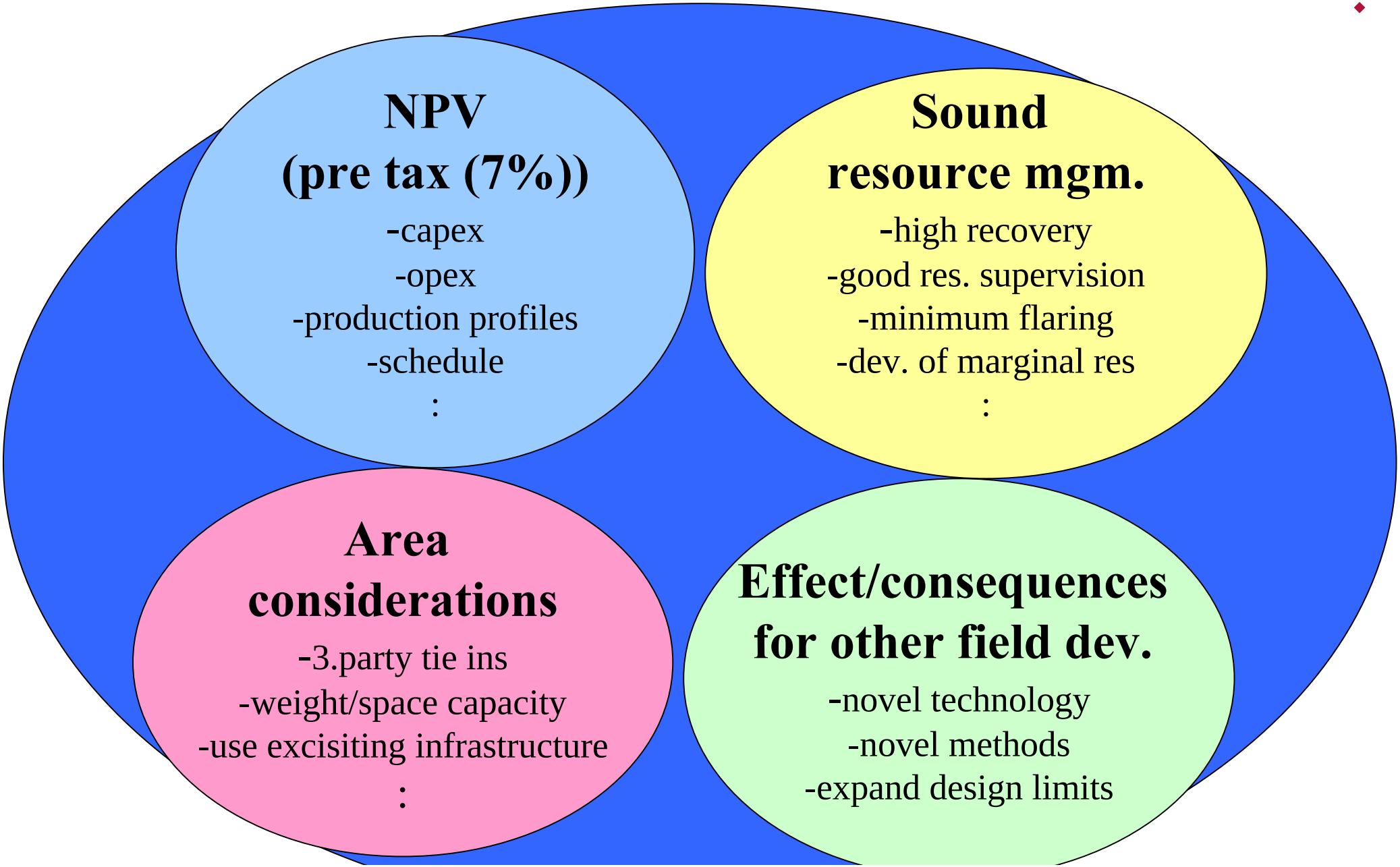
- Company taxation
- High marginal tax rate
- Expensing R&D costs as part of company opex

- Reduces actual company-cost and risk for development of novel technology

Aspects in NPD evaluation of field dev.

- Socio economy
- Health, Safety, Environment (HSE)
- Environment

Socio-economic evaluations



Socio-economy-novel technology evaluations

- Effect on economy (pre.tax NPV (7%))
  - capex, opex, recovery, production profile, project schedule…
- Possibilities/limitations for good reservoir management
- Flexibilities or limitations for 3. party tie- ins (area considerations)
- Potential for the use of novel technology in other field developments on the NCS

Evaluation of project risk

- Does the plan include a good description of the risks involved in the project?
  - Cost
  - Schedule
  - Production profiles
  - Novel technology qualification
- Fall back solutions if technology qualification fails
- Economic consequences if technology qualification fails

PDO-documentation –novel technology

- Document that the proposed solution is favourable wrt socio economy compared to alternatives
- Describe novel technology influence on resource management.
- Describe the project risk-evaluations
  - Economic consequences if failing in qualifying technology
  - Economic robustness
- Programme for qualification of novel technology

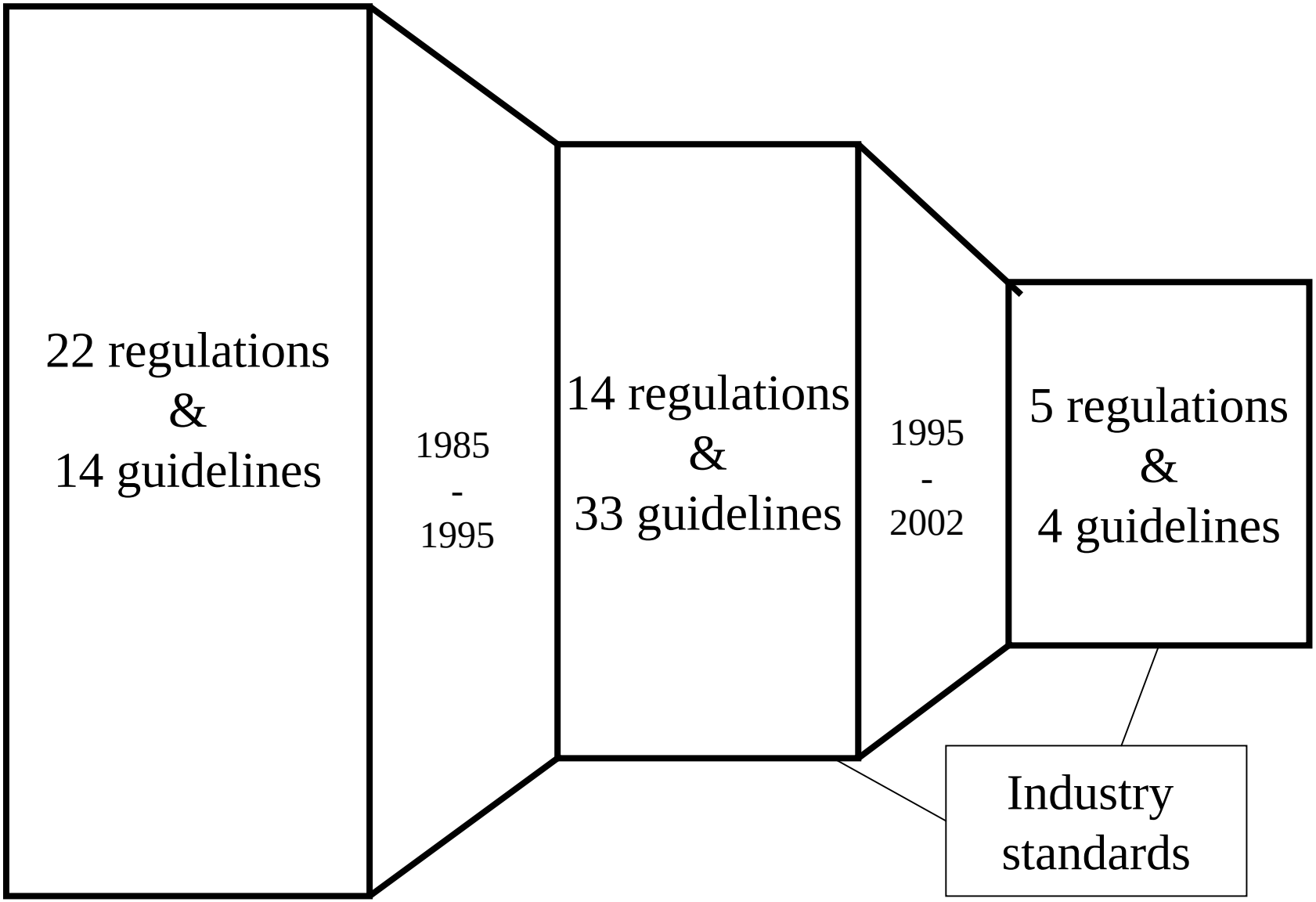
PDO-evaluations (socio economy)

- Economic criteria's (project, area)
- Sound resource management (recovery, reservoir supervision…)
- Project risk evaluations
- Technology qualification programme
- Novel technology influence on other developments

HSE (general remarks)

- The systematic change in regulations from ”*detailed*” to ”*function- oriented*” has opened up for more use of novel technology
- Novel technology is one way of improving HSE-level
- The NPD has a duty to practise a precautionary principle
- The NPD supervisory activity has focus on the companies criteria's for qualification of novel technology

Adjustments in HSE regulations 1985 -2002



Purpose of the new HSE regulations

- More comprehensive and coordinated regulations
- A basis for better co-ordination of the supervisory-activity
- Inter- disciplinary regulations
- Simplification/reveal conditions
- Predictability

HSE – Main changes in new regulations

- Increased use of of function-based requirements
- Less specific requirements
- Increased number of references to Industry Standards
- More strict requirements on the management side

HSE – regulations wrt novel technology

- **§20 ”The Framework regulations” (PDO documentation)**
  - ” …The documentation of the development part shall include a programme for qualification of novel technology, …”

- **§8 ”The Facility Regulations” (Qualification)**
  - ” In cases where the petroleum activity entails use of novel technology or methods, criteria’s for development, commissioning and use shall be outlined such that the requirements for health, environment and safety are fulfilled. The criteria’s shall be representative for the actual use, and the technology and methods shall be adjusted to already accepted solutions. The qualification and commissioning shall demonstrate that current requirements can be fulfilled by use of the novel technology or method.”

Conclusions from the Kaasen Commitee

- Insufficient
  - preparations of the decision basis and the decision process
  - project maturity
  - management of project uncertainties due to risk-underestimation (novel technology)
  - planning of drilling- and completion operations
  - qualification of equipment and vendors (need for follow-up)
  - contract management, co-ordination between contracts and competence in customer/vendor relations
  - transfer of experience (operating company to vendor)
  - management in project definition phase and in implementation phase
  - competence wrt. Regulations
  - knowledge of NORSOK standards

The environment- NPD focus

- How does novel technology contribute to obtaining national commitments regarding emission to air or discharges to sea?

- Focus on the possibilities for including the best available technology wrt. emissions to air and discharges to sea in new field developments.

The environment- International commitments

- **UN Framework Convention on Climate Change**
  - Reduce growth in the total emission of greenhouse gases to 1% from 1990 to 2008-2012.
  - In White Paper 54 (2001) the establishment of a national quotation system from 2008 is proposed.

- **Gothenburg protocol**
  - Reduce the Norwegian emission in 2010 from 1990 level:
    - NOx by 29% and nmVOC by 35%

- **OSPAR Convention (Oslo-Paris Convention)**
  - Upper limit of 40 mg dispersed oil per litre produced water discharged to sea. (recommended limit of 30 mg/l from 2006)
  - Reduction in the total discharge of produced water to sea by 15% from 2000 to 2006.

The environment- Challenges

- **Greenhouse gases**
  - Continuous development and implementation of technology as contributions to fulfilling the Norwegian commitments.
- **NO_x**
  - Find cost-efficient solutions which can reduce the emission from existing installations
  - Ensure low NOx emission from new field developments.
- **Discharge to sea**
  - Find solutions for obtaining national objectives of ”0-discharge to sea” especially for future activity on deep waters and areas close to the coastline.

The environment- Needs for technology dev.

- Continuous improvements of subsea- production installations and down hole- separation
- Study potential for CO_2 injection.
- Potential for power cable from shore.
- Energy efficient process plants and combined cycle power plants.
- Low-NOx dual fuel turbines.
- Improve purification-technology

The environment- General experience

It takes too long time for a novel technology to come in actual use

Total NPD-evaluation