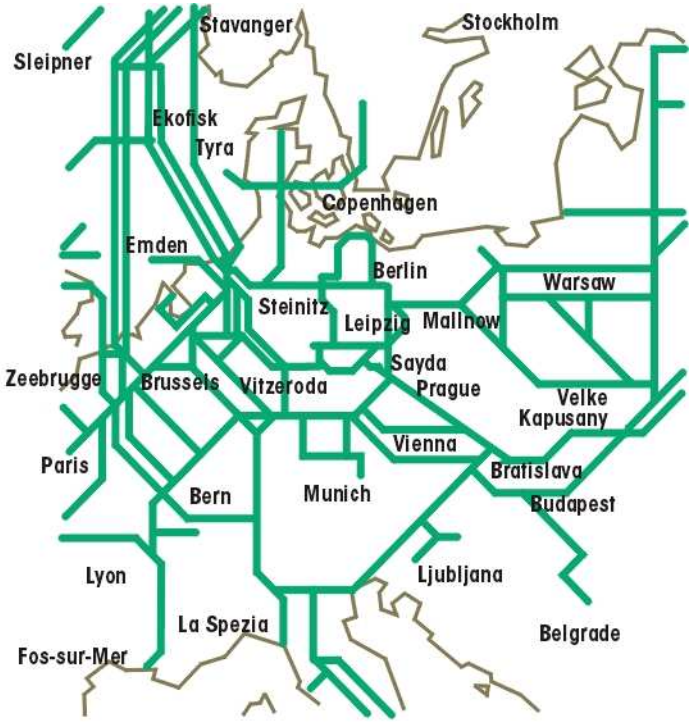
# Condition-oriented maintenance of technical systems in Underground Gas Storage Facilities at VNG Verbundnetz Gas AG

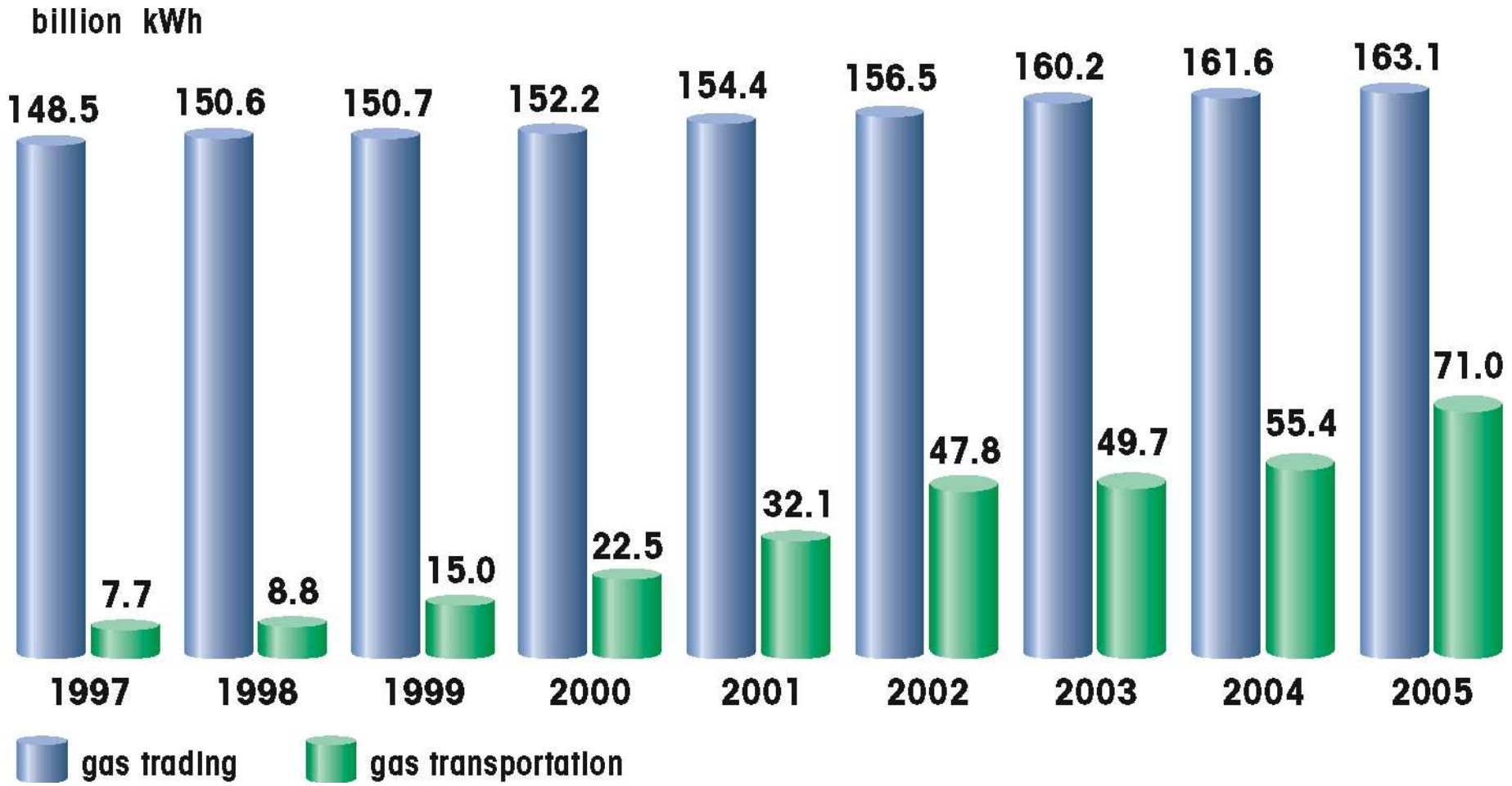
**Referent: Dipl.-Ing. Bernhard Ott, maintenance Management**

# VNG - Verbundnetz Gas Aktiengesellschaft

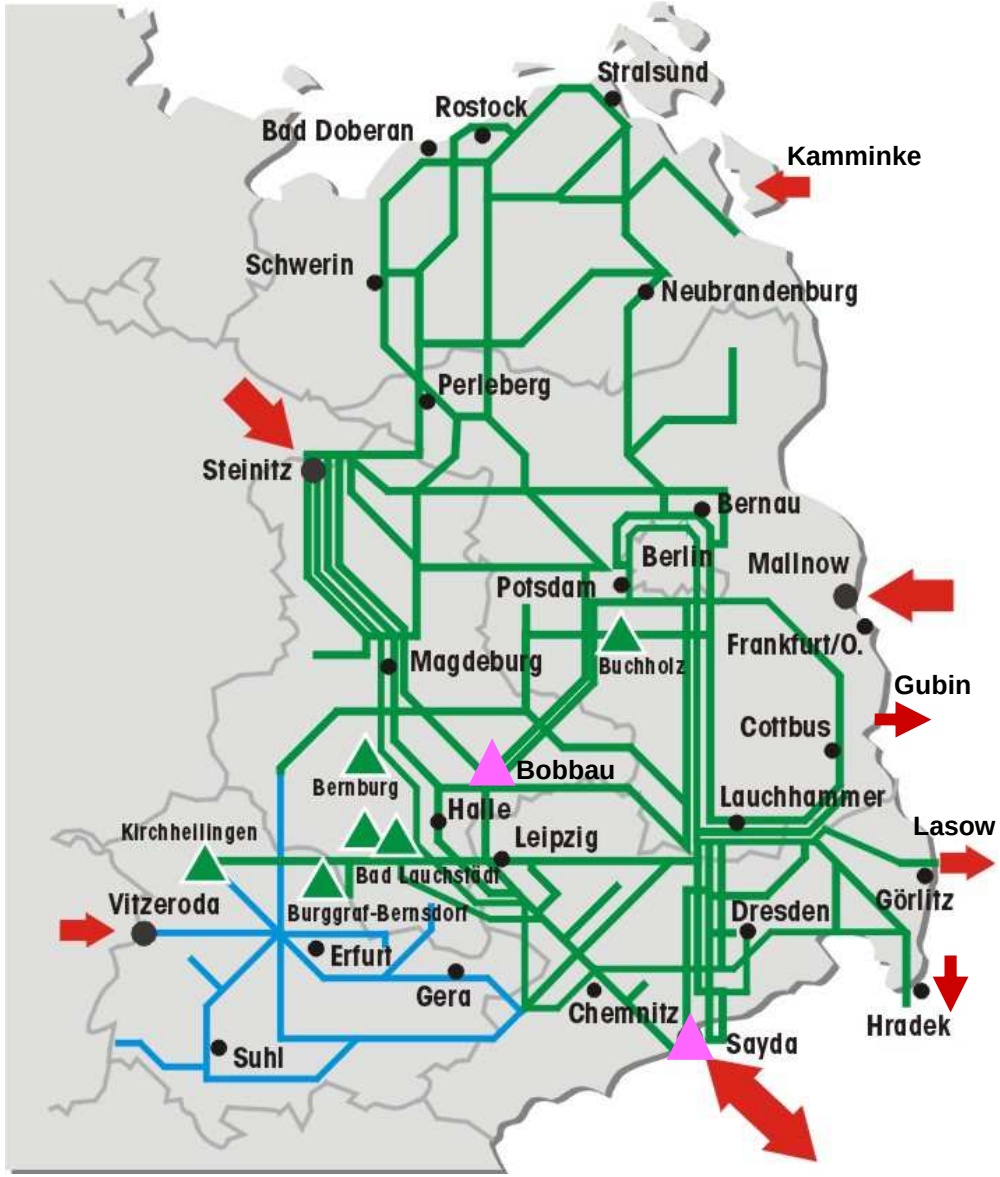
| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|
| Total gas sendout (billion kWh) | 148.5 | 150.6 | 150.7 | 152.2 | 154.4 | 156.5 | 160.2 | 161.6 | 163.1 |
| Share in German gas consumption (%) | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Turnover (billion €) | 1.93 | 1.82 | 1.69 | 2.60 | 3.10 | 2.89 | 3.32 | 3.32 | 3.81 |
| Employees | 1,143 | 1,132 | 1,057 | 910 | 743 | 689 | 682 | 669 | 651 |
| Net income for the year (million €) | 15 | 46 | 34 | 55 | 96 | 105 | 124 | 123 | 94 |



# VNG trading and transportation volumes



# VNG maintenance strategy




- **Length of pipelines:** 7,279 km
- **Underground gas storages:** ▲ 6 (at overall 5 sites)
- **Total work gas capacity:** 2.3 billion m³
- **Compressor stations:** ▲ 2 (+ 4 compressor units UGS)
- **Total compression capacity:** 77.8 MW (8 piston compressors 7 turbo compressors)
- **Delivery stations / links:** 8 →
- **Metering and pressure regulating stations:** 36
- **Assets of cathodic corrosion protection:** 727

# VNG maintenance strategy

## Demands for maintenance process at VNG

- A high level of availability
- High safety standard of providing
- Adherence to law
- Low cost rate for operational procedure and
- Low cost level for maintenance process

# VNG maintenance strategy

## International standard maintenance methods

- **Failure-based maintenance**
  **(whenever a failure / damage occurs)**

- **Planned preventive maintenance**
  **(Predetermined / periodical / preventive maintenance at constant intervals to suit specific criteria)**

- **Condition-based maintenance**
  **(periodical determination of wear, maintenance at a time which suits production planning)**

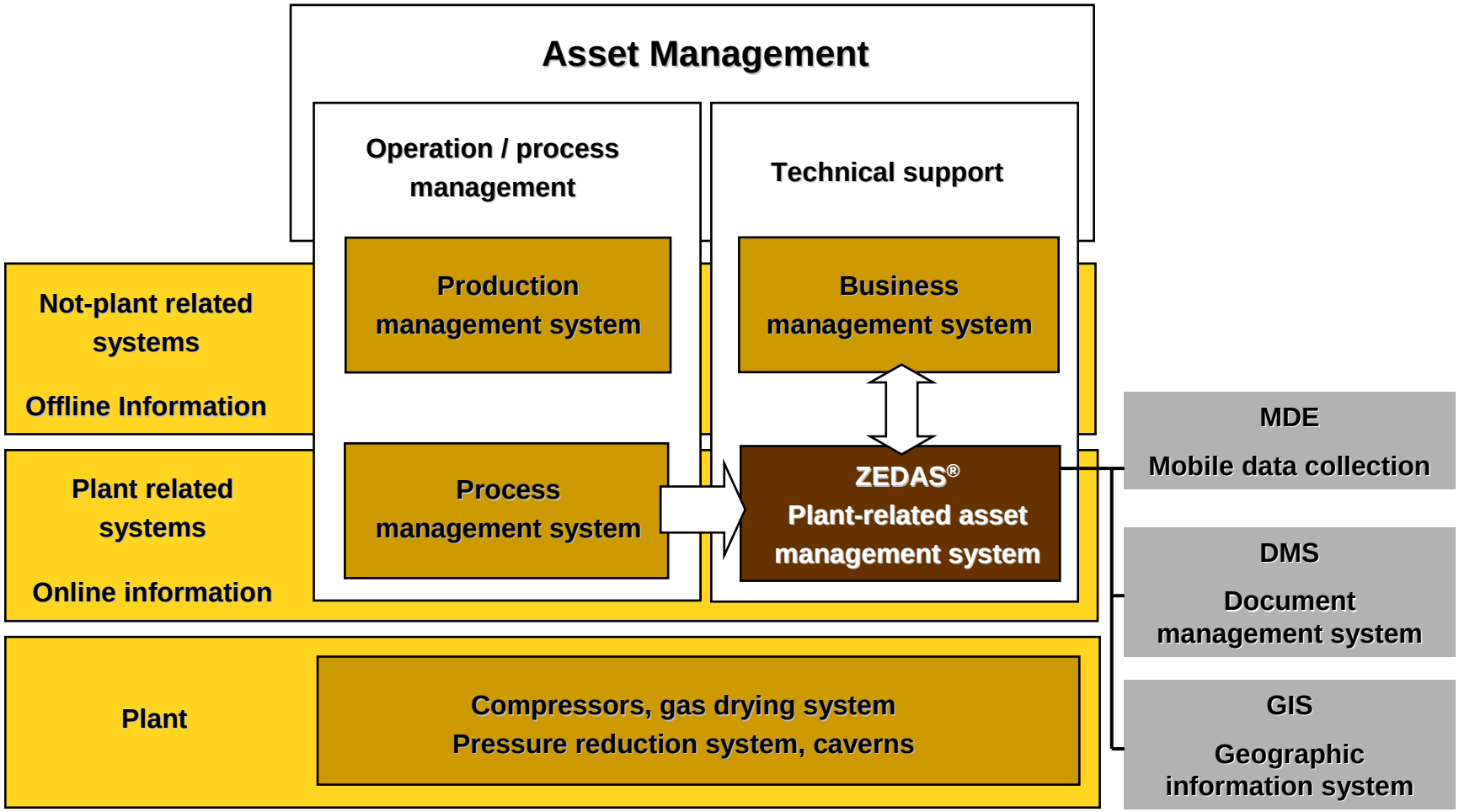
# VNG maintenance strategy

## Stand by equipment and capacity reserves

**Analysis of operational procedures at the recent years**

- **Analysis of capacity of plant systems**
- **The frequency of critical loads**
- **Equipment permanent works at a low load level**

# VNG maintenance strategy




## Classification of ZEDAS system in terms of NAMUR recommendation NE 91

# VNG maintenance strategy

## Aims of introduction management software ZEDAS

- Detected defects early before system has suffered major damage
- Practice condition-based planning for inspection, upkeep and repair
- Optimize operation through direct rating factor / efficiency / energy consumption and
- Statistically follow up on events / damage to individual plant components (units, apparatus, instruments, equipment etc.) and
- Analyze failure frequency

# VNG maintenance strategy

## Plant components

- Compressors
- Gas drying / gas purification systems
- Pressure reduction systems and
- Gas storage caverns / wells

# VNG maintenance strategy

## Interpretation

- **In result of using the IT-control-system, VNG get a lot of information about:**
  - **specific plant cost**
  - **equipment running time**
  - **increasing rate of failure and**
  - **cause of failure**

# VNG maintenance strategy

## Data tracks per technical units of UGS Bernburg

| *Technical units* | *Compressor* | *Gas drying system* | *Pressure reduction system* | *Caverns* |
|---|---|---|---|---|
| *Total* | *143* | *33* | *160* | *133* |

## Data tracks of process factors at UGS Bernburg

| *Process factor* | *Retention time, days* | *Scanning intervals, seconds.* |
|---|---|---|
| *analogue data:* | *temperature93* | *600 (10 minutes)* |
| *analogue data:* | *pressure etc.93* | *(10 minutes)* |
| *binary data* | *732* | *2,400 (40 minutes)* |
| *cavern data* | *732* | *7,200 (120 minutes = 2 hours)* |

# VNG maintenance strategy

## Project steps include:

- Developing and implementing a data flow / security concept for coupling commercial and production networks
- Selecting data tracks for units, drawing up maintenance plans, setting intervals and
- Analyzing load-descriptive parameters with a first definition of links and message / alarm values (rules)

# VNG maintenance strategy

## Advantages of ZEDAS (I)

- Every plant obtains a special strategy of maintenance
- Older flow of work is completely changed
- Job orders will be reduced
- A better documentation of failure and technical-examination for a lot of equipment
- The examination of device-function could be reduced up to 30 %

# VNG maintenance strategy

## Advantages of ZEDAS (II)

- Better operating safety / plant reliability
- Lower maintenance costs (efficient working)
- Better fail safety of technical systems (minimal downtime / preventive diagnosis / more effective troubleshooting)
- Optimization of cost-benefit ratios for monitoring / diagnosing systems and
- Support to prove conformance to safety rules

# VNG maintenance strategy

## The following approach to projects is recommended:

1) Develop / implement a concept for organization, data flow and data security, particularly when coupling commercial and process control networks

2) Select process information to be imported online (data tracks from PLS / SPS) for units chosen in keeping with risk assessment – includes drawing up maintenance schedules and observing time limits

3) Analyze load-descriptive parameters, give a first definition of links and of message / alarm values (alarm rules)

4) Gradually optimize maintenance / inspection intervals making allowance for (failure) frequency and damage classes (see also VGB leaflet M 130 and DVGW worksheets G 495 and W 400/3)


Thank you for your
attention!