KUALA LUMPUR 2012 WORLD GAS CONFERENCE

IGU

25th world gas conference

"Gas: Sustaining Future Global Growth"

Trends in Underground Storage Business and New Projects

Underground Gas Storage Projects For New Gas Markets

By: SG 2.1, Ladislav Goryl, Vladimir Lorenc, NAFTA a.s.

Date: June 4-8, 2012

Venue: World Gas Conference 2012

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Agenda

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- New projects
- Storage demand prognosis
  - Methodology
  - World
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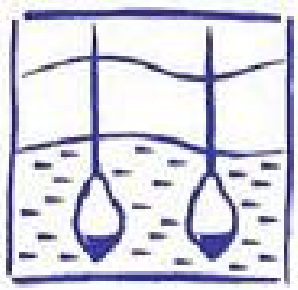
- Technical & commercial trends
- New opportunities for storage
- Conclusions



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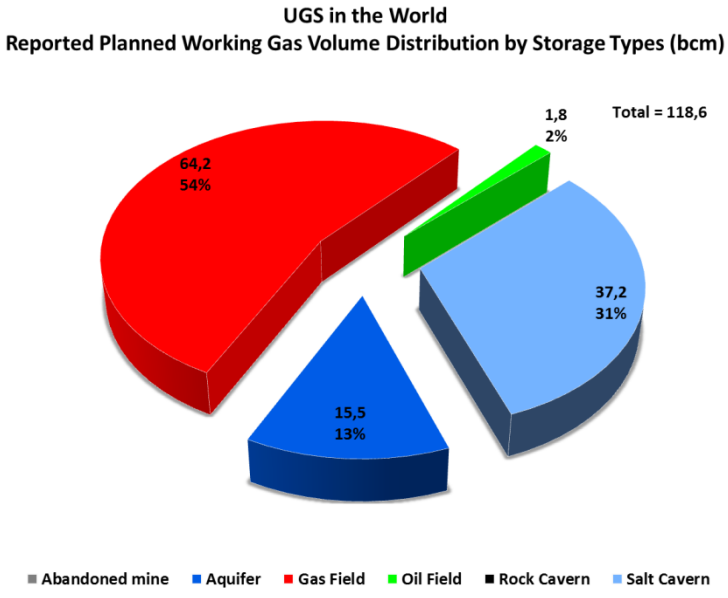
UGS Database – basic figures @ 2010/2011

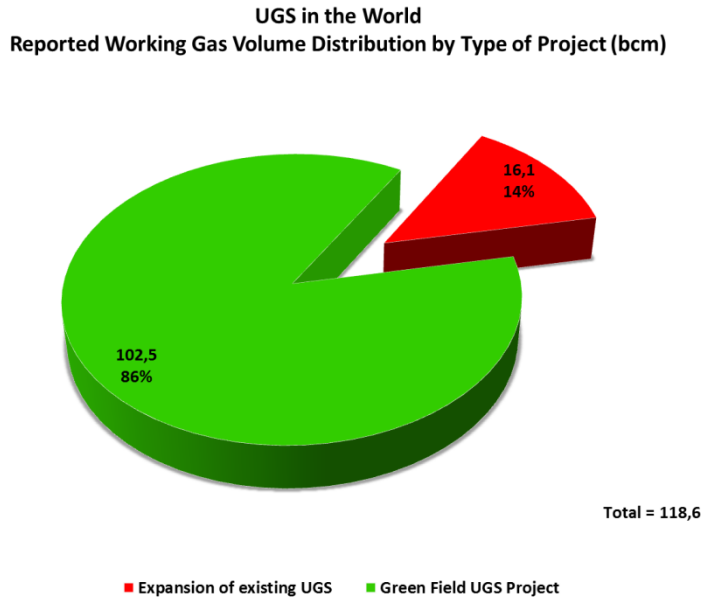
World	No. of UGS Facilities	WGV (bcm)
UGS in operation*	**693**	**358.8**
Planned developments in existing UGS	32	16.1
Planned new (Greenfield) UGS	120	102.5
Potential	31	22.0
Planned and potential developments	**183**	**140.6**
Total - UGS in operation and planned	**844**	**499.4**

* Without 40 bcm long term strategic reserves of Russia

UGS Database – new projects basic figures

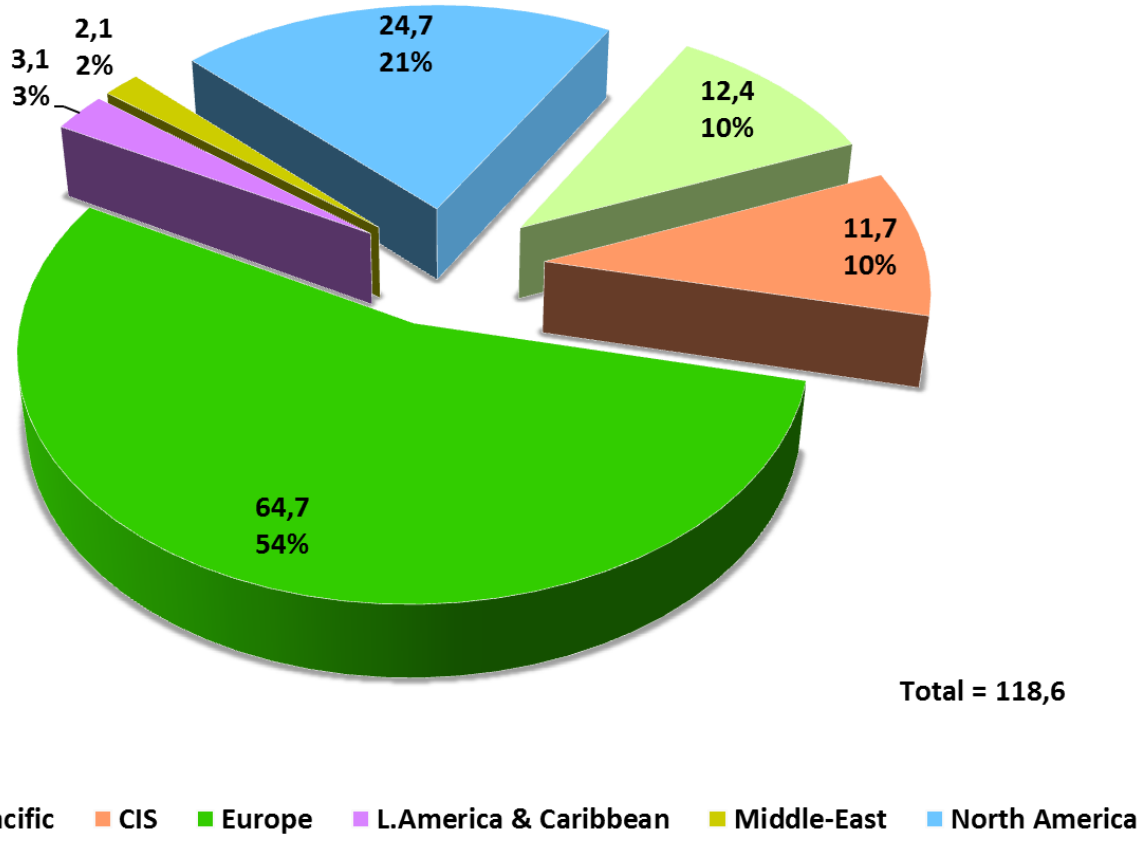
- **118,6 bcm=>new projects (total number)**
- 38,6 bcm=>projects in advanced stage (budget approval & under construction)
- 64,2 bcm (54%)=>projects in gas fields
- 102,5 bcm (86%)=>green field projects





UGS Database – Regional distribution

- 54% (64,7 bcm) out of worldwide planned projects announced in Europe, however; it might be influenced by high European participation in Study Group (SG)



Storage Demand General Trends I

- Decrease of indigenous productions, increasing distance between gas supply & demand centres requires a flexible physical asset in gas chain
  - Flexibility for balancing (seasonal, peak – growing renewables, gas power plants)
  - Flexibility & gas for Security of Supply
- Growing acceptance of gas in „clean“ energy mix & Growing markets
- Changing gas supply pricing mechanism & growing liquidity at gas hubs needs commercial instrument
  - Offering gas price arbitrage opportunities
  - Protection against volatile gas prices
- Convergence of electricity & gas markets = **Energy storage means Storing not gas but energy**
- Flexible storage reacts quickly with flexible & tailor made products
  - A broad portfolio of products for gas suppliers and traders
  - Gradual entry of financial products & their transposition in gas storage
  - Secondary trading, title transfers of gas

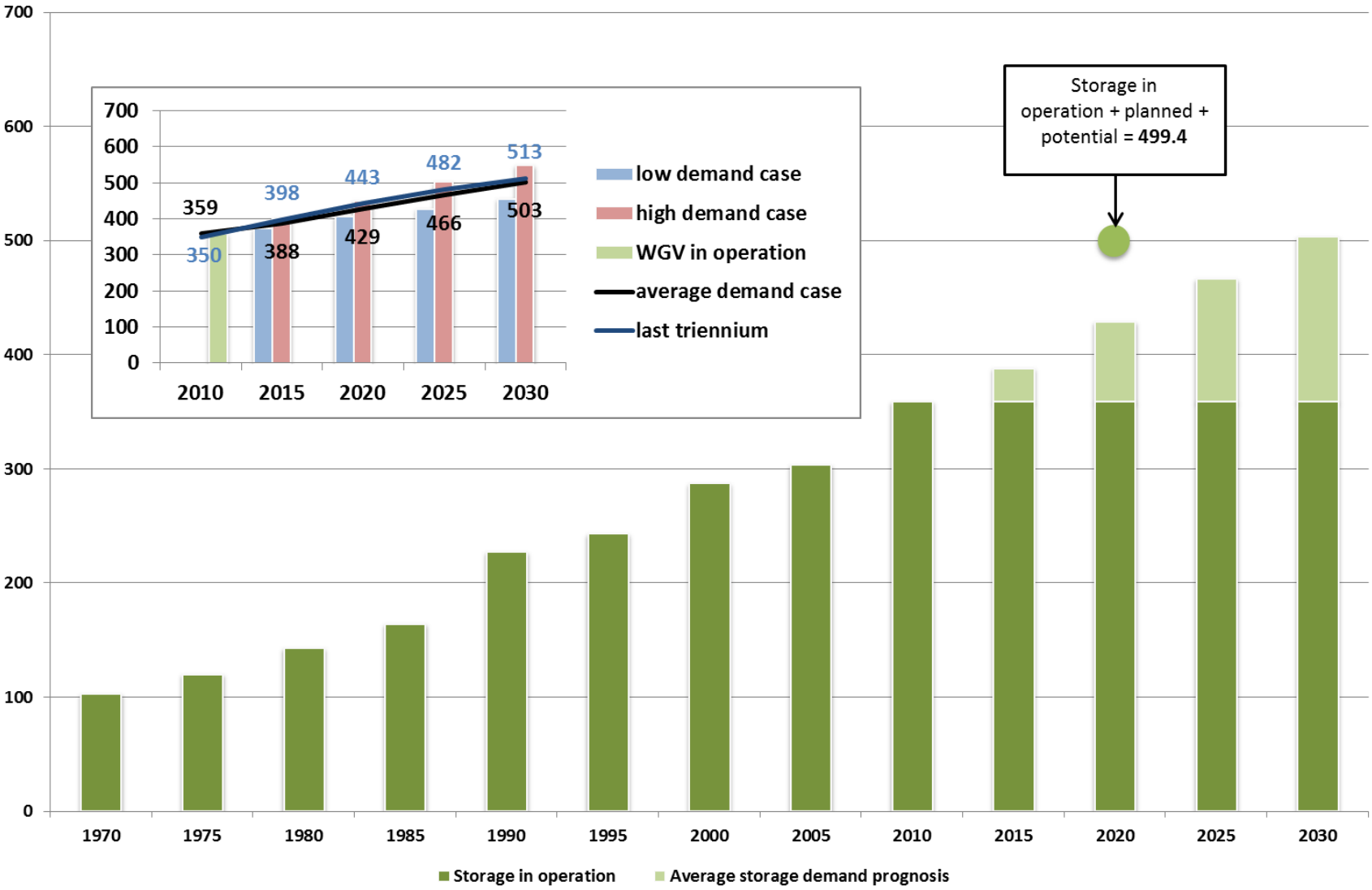
Storage Demand General Trends II

- Storage depends on gas competiveness in energy mix
- Storage under competition of other gas infrastructures
  - Pipeline
  - LNG regas terminals
  - Production
- Growing environmental and safety regulation
  - Increase of CAPEX
  - Demanding permitting
- Frequently changing legal & regulatory framework e.g. in Europe

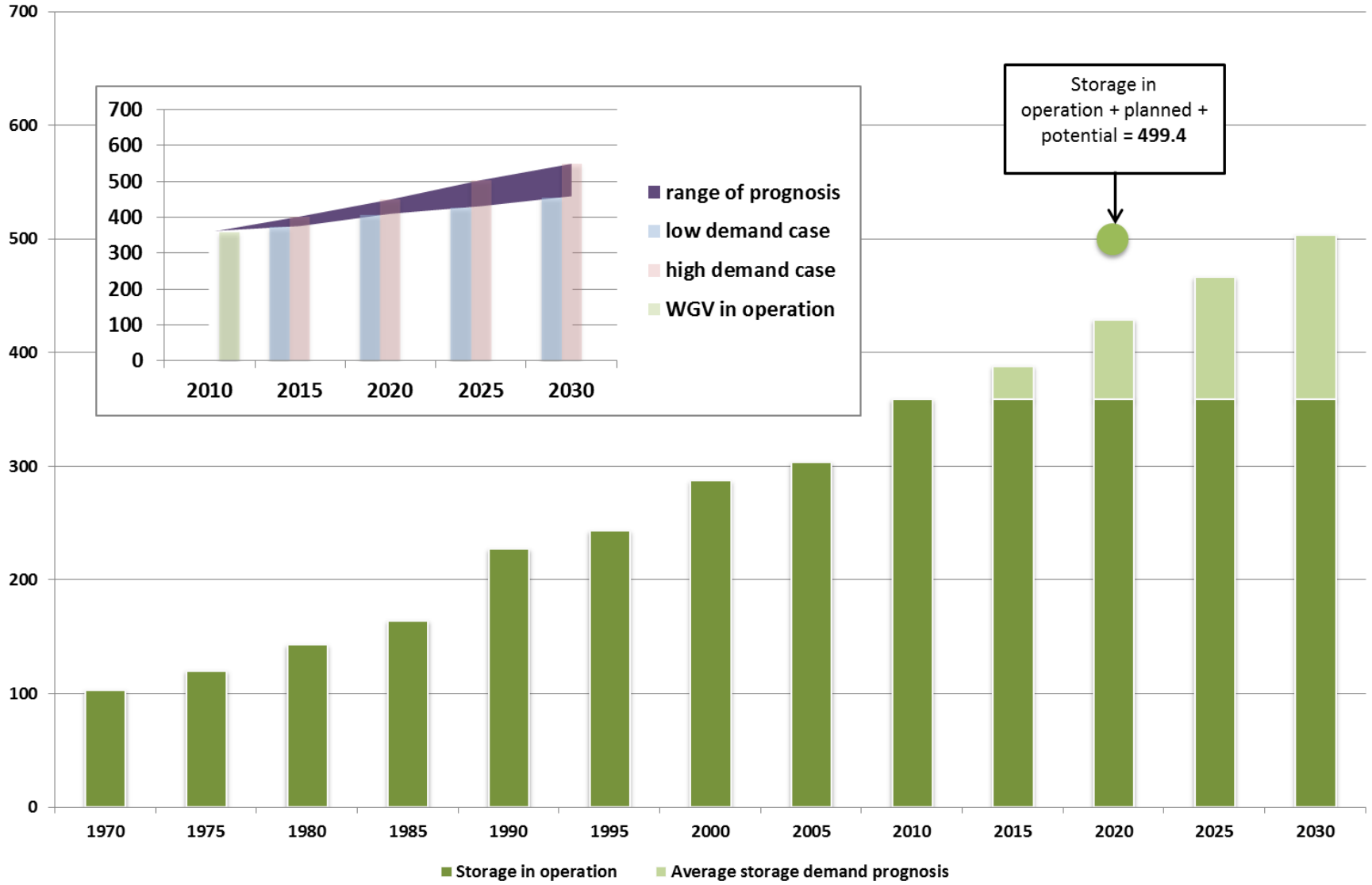
Storage demand prognosis - methodology

- Prognosis based on definition of regional trends with variable drivers
  - Additional demand on flexibility due to renewables, trading activities...
  - Security of supply
  - Gas market development
- Regional gas demand up to 2030 defined by PGC B
- Ratio of WGV to Gas demand in developed regions (17 – 20%)
- Major regional trends defined as a span
  - Low demand case
  - High demand case
- Verification of prognosis
  - Extrapolations from previous years
  - New projects in storage database

World storage demand WGV (bcm)prognosis

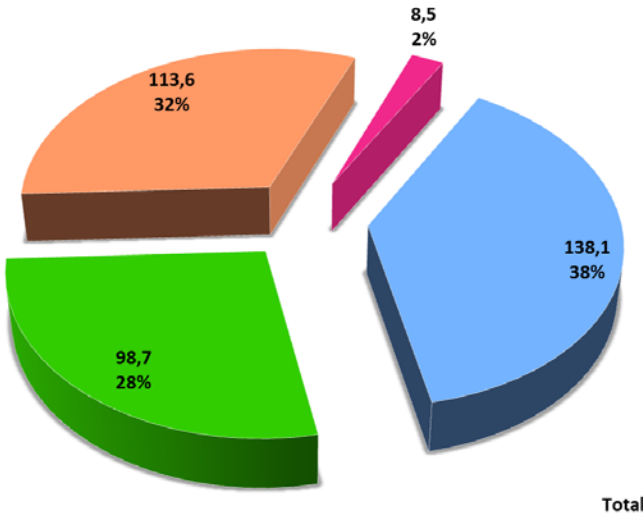


World range of prognosis (bcm)

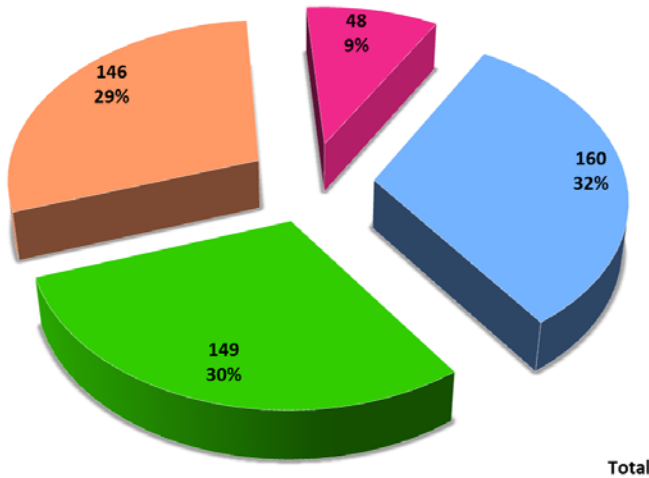


WGV (bcm) regional distribution 2010 vs 2030

2010 Actual



2030 Forecast



North America Europe CIS Others

Storage demand prognosis

NORTH AMERICA

- 18% WGV/Gas demand
- Growing gas demand due to shale gas

- Storage used by traders & power generation
  - Demand on rates rather than volumes
- Shale gas revolution
  - Decrease of needs for SoS
  - Storage abandonment

CIS

- Growing gas demand 17,5 % WGV/Gas demand

- Rates need to be increased substantially

EUROPE

- 17,6% WGV/Gas demand
- Decreasing indigenous production=high import dependency => SoS
- Renewables, phase out of nuclear plants
- Further market liberalization

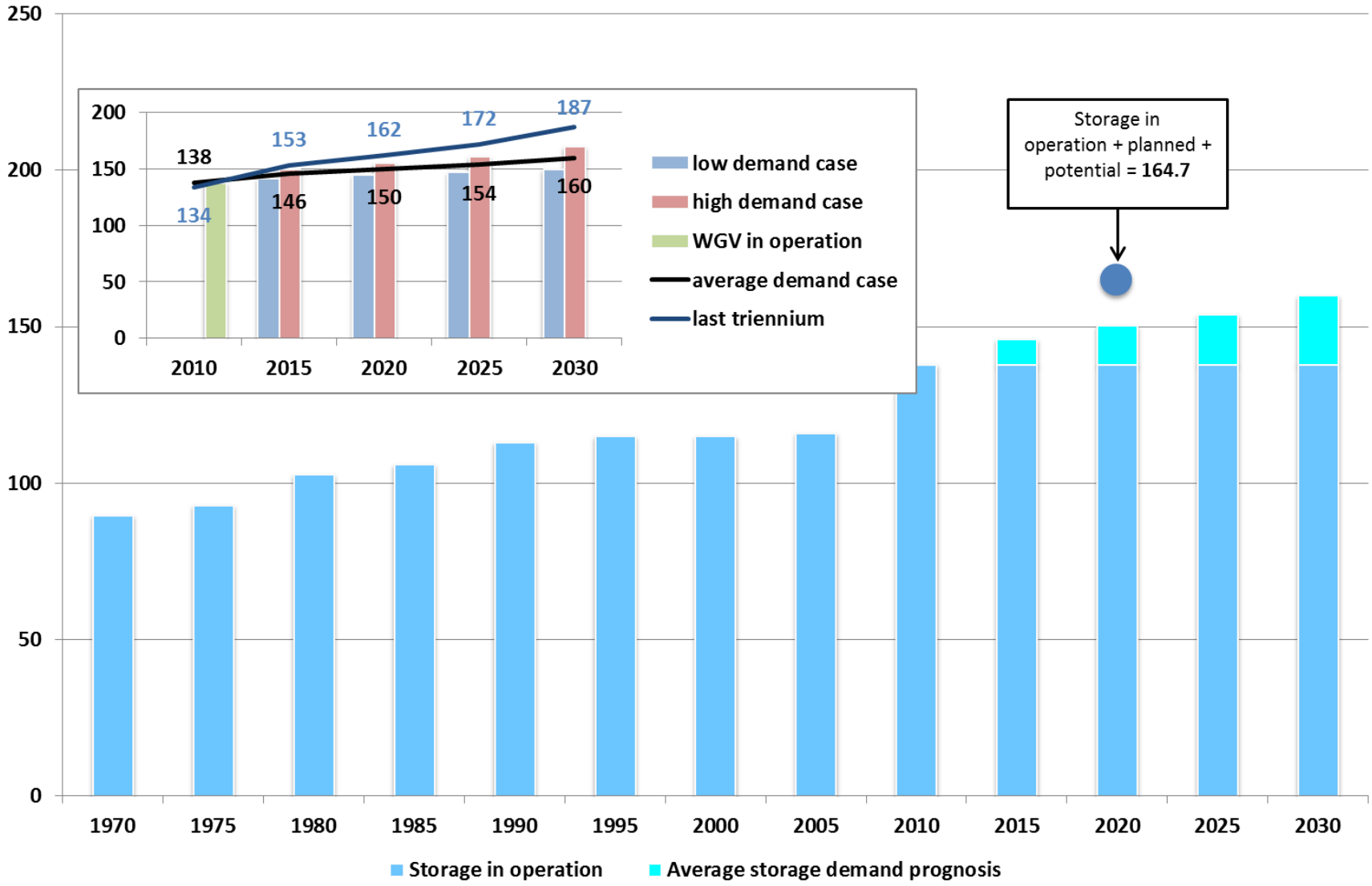
- Growing flexibility from pipelines and LNG regas terminals & interconnections
- Quickly changing legal and financial regulation
- Demanding permitting

OTHERS

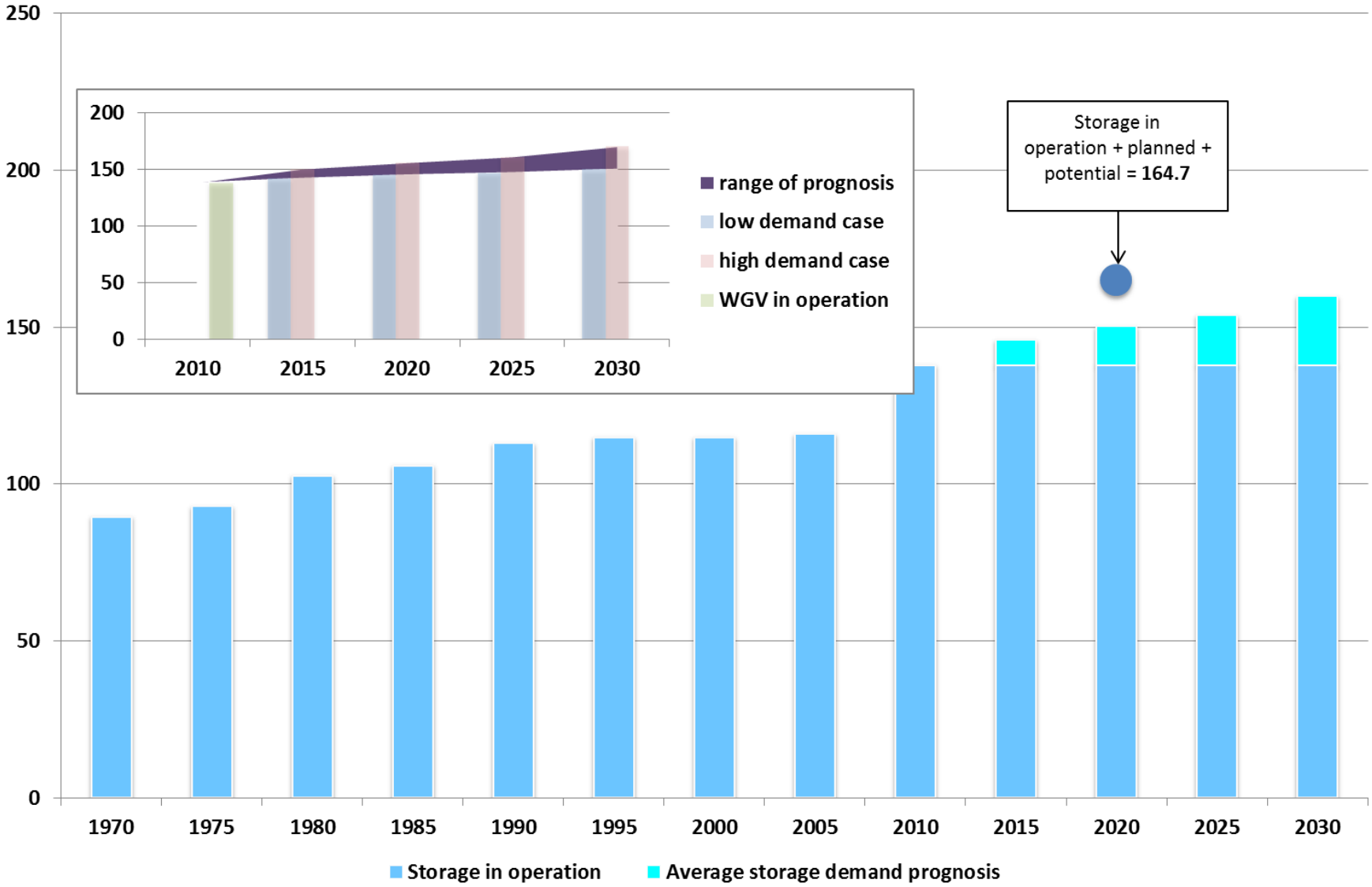
- Growing gas demand (China, Iran)
- Re-assessment of nuclear power (Japan)

- Limited suitable geologic formations (Japan, South Korea)
- Significant engineering capacity needed
- Long lead times and capital intensive projects

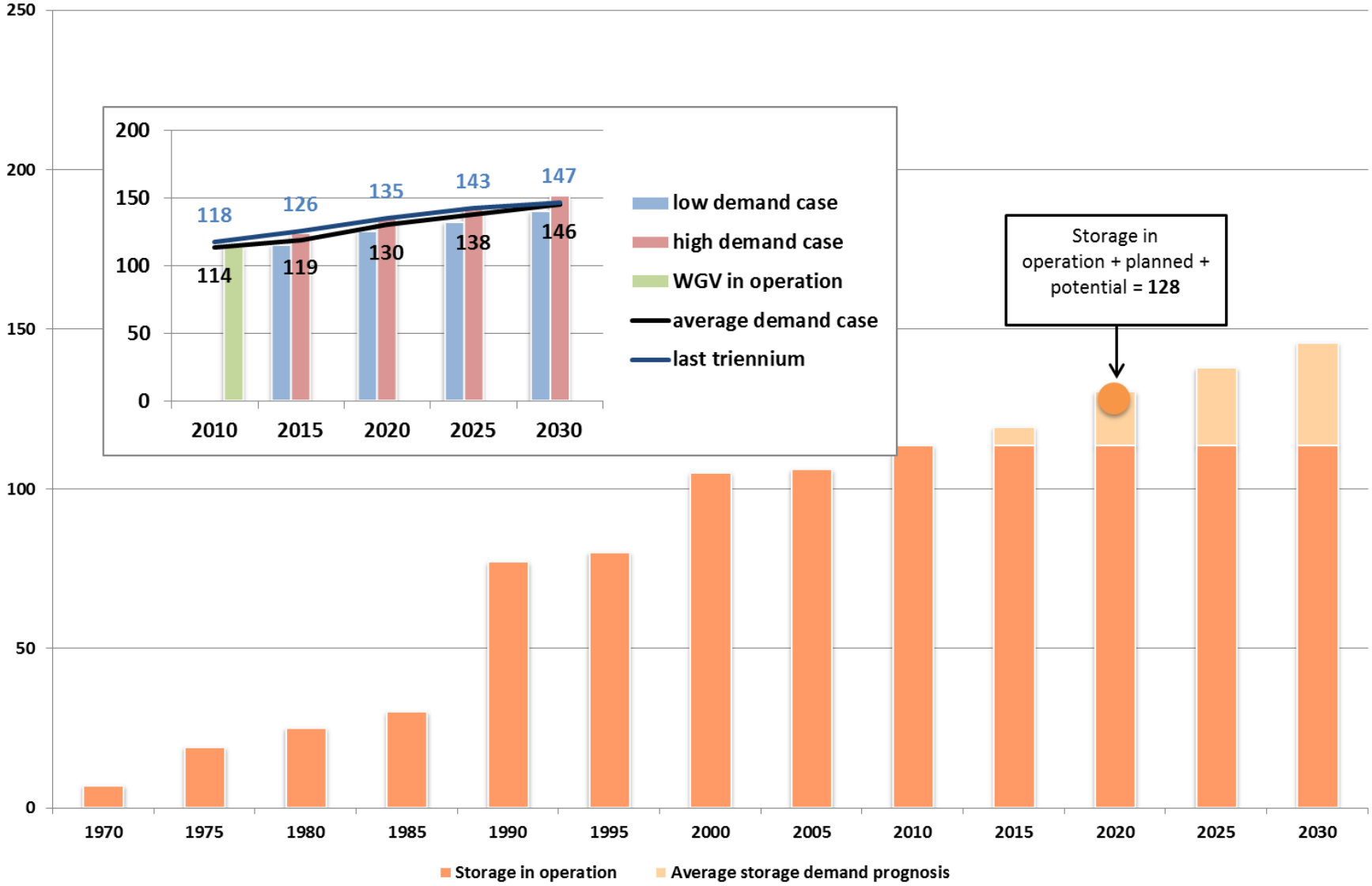
North America storage demand WGV (bcm)prognosis



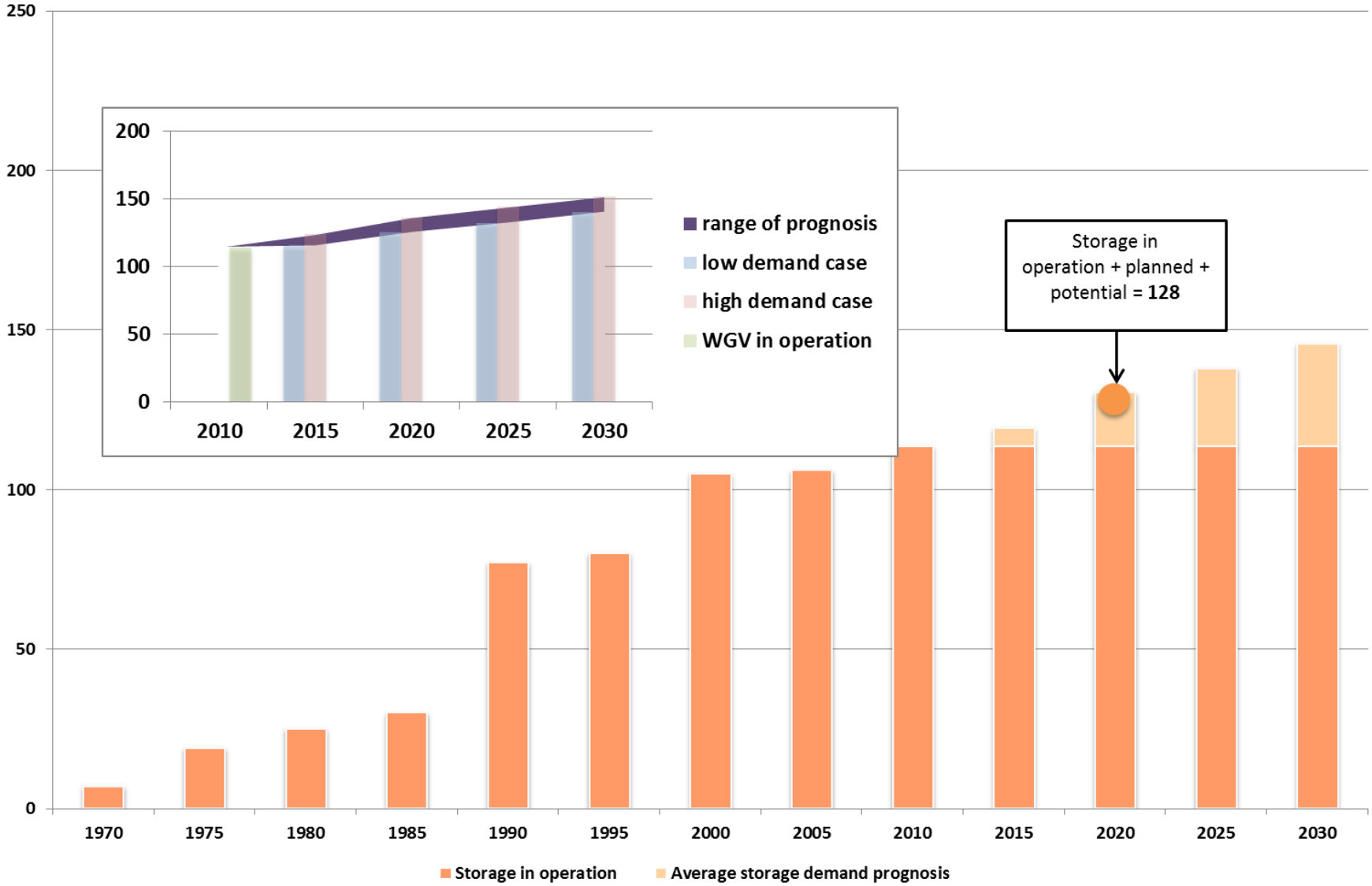
North America range of prognosis (bcm)



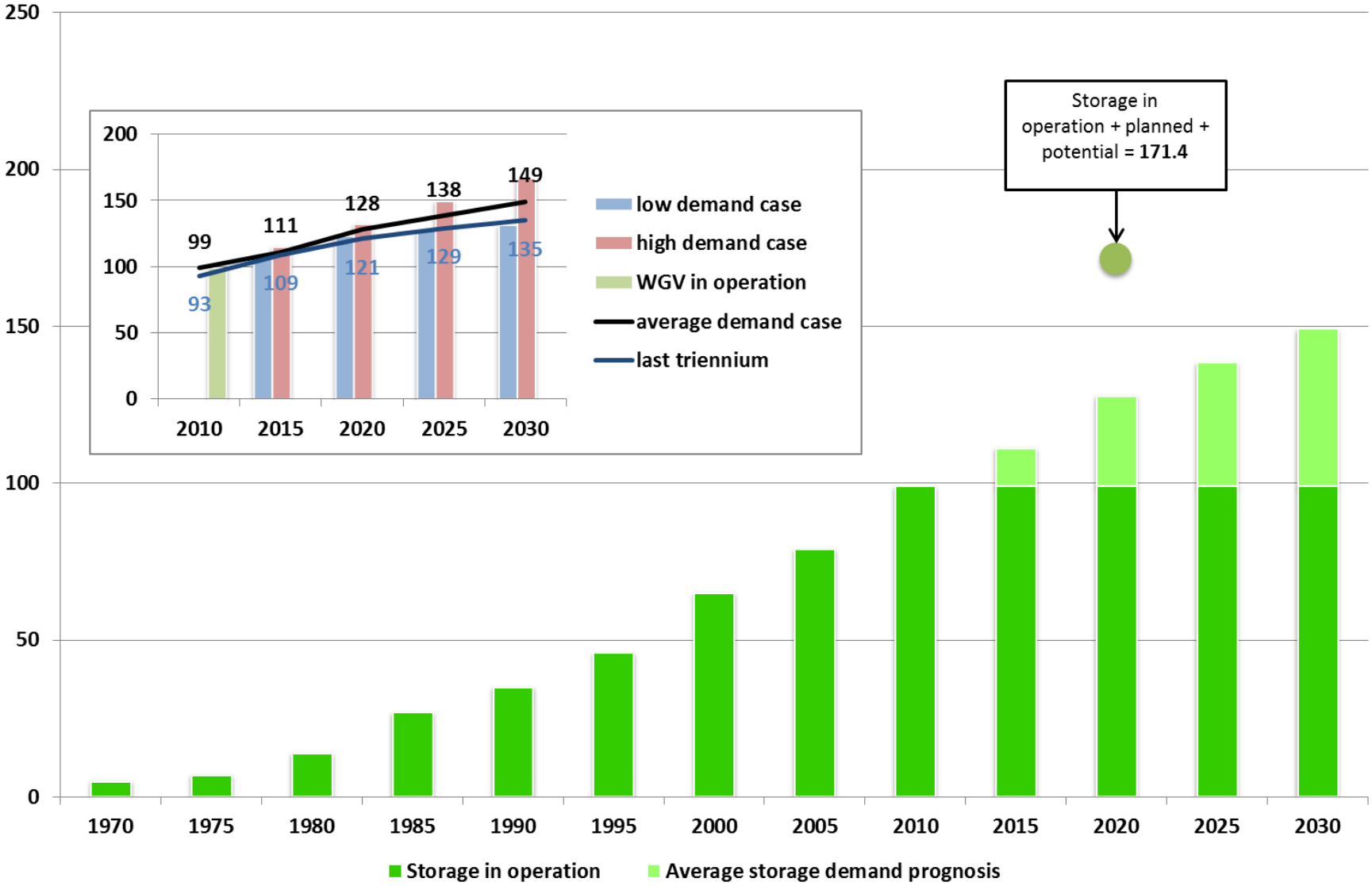
CIS storage demand WGV (bcm)prognosis



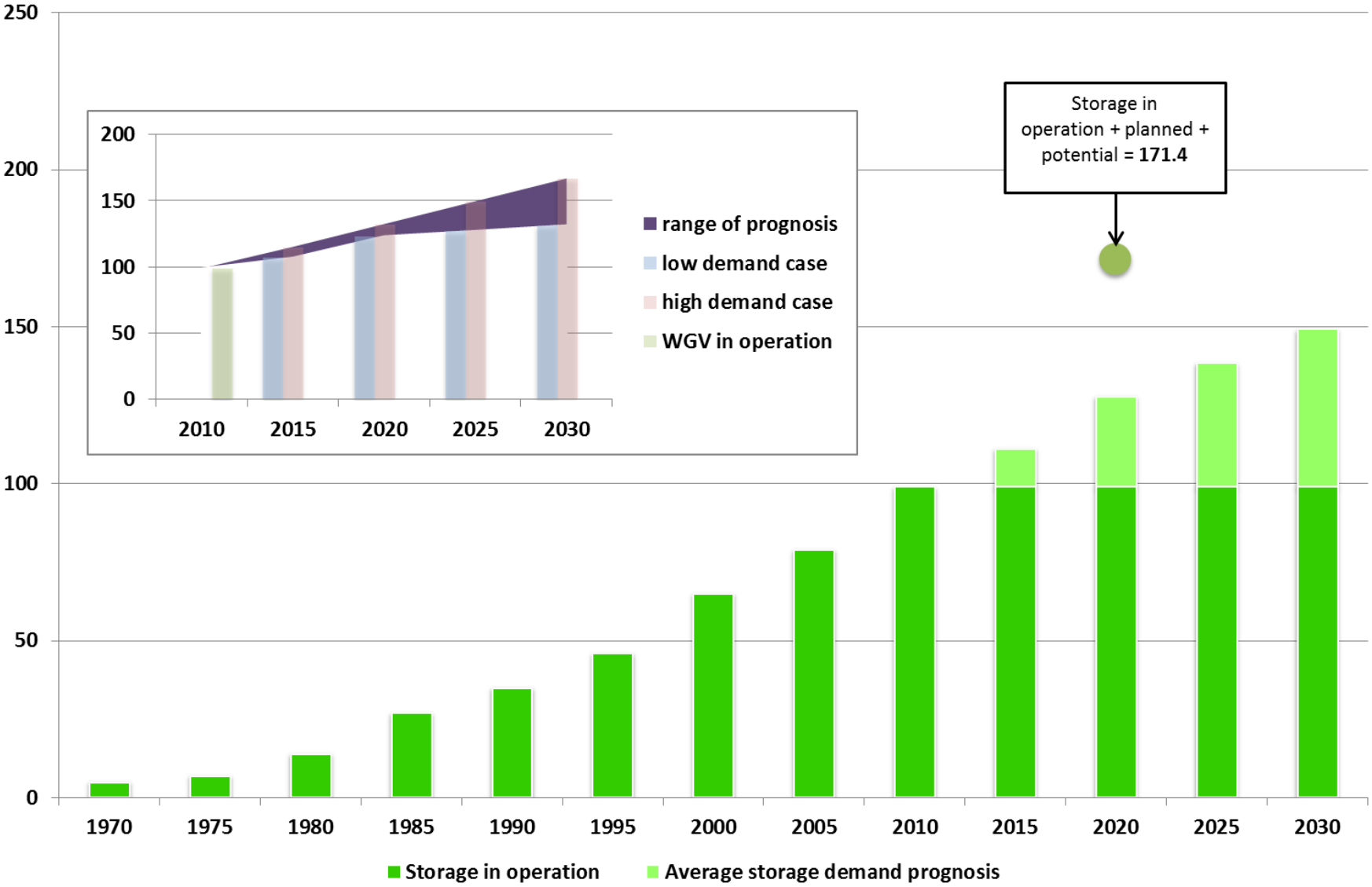
CIS range of prognosis (bcm)



Europe storage demand WGV (bcm)prognosis

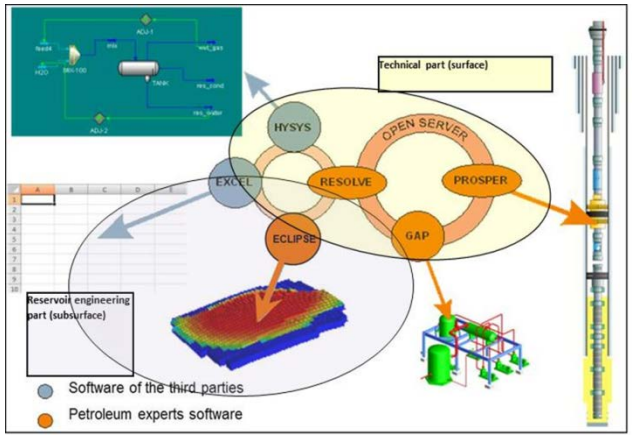


Europe range of prognosis (bcm)



Technical trends

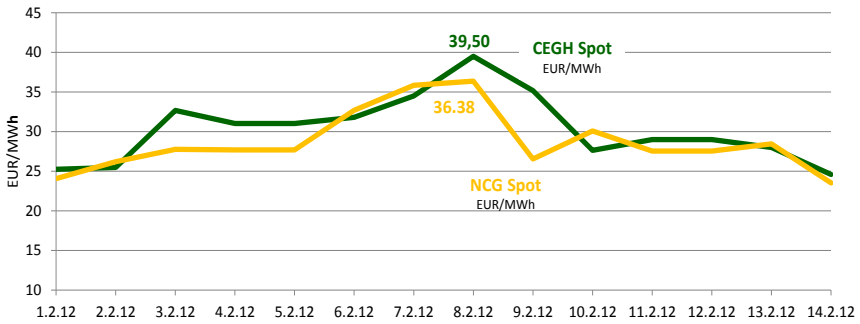
- **Porous storages**
  - Increase of „delta p“ and decrease of minimum operating pressures => efficient development of WGV
  - No alternative cushion gas reported
  - Sophisticated and integrated models used for storage development and its operation
  - Sample analysis and geomechanical model used for wells completion and storage integrity
  - Well integrity and its re-completion with SSVs (Europe)
  - Investments on „de-bottlenecking“ of storage infrastructure and increase withdrawal performance



- **Caverns**
  - Operation of deep caverns at constant pressure using brine stored in nearby aquifer
  - The cluster design with S shaped wells, high diameters 20“ and under 75°
  - Increase maximum and minimum allowable operating pressures and pressured gradients linked to higher daily rates

Commercial trends

- Value of storage much strongly influenced by
  - Development of summer/winter spreads (intrinsic) and short term volatility (extrinsic)
  - Interconnections to grids
  - Vicinity to gas hubs
- Quickly React to requirements of clients
- Reduction of barriers & limits (technical minimum, start up time, shutdowns...)
- Innovative products (apart from Bundled & individual storage products)
  - Bundled storage& transmission products
  - Book & store platforms
  - Tailored made product (customization by individual rates)
  - Products derived from financial markets e.g. options
  - Title transfer within storages
- Pricing based on summer – winter spreads as
  - Fixed fee
  - % of spread
- Increased importance of short term products

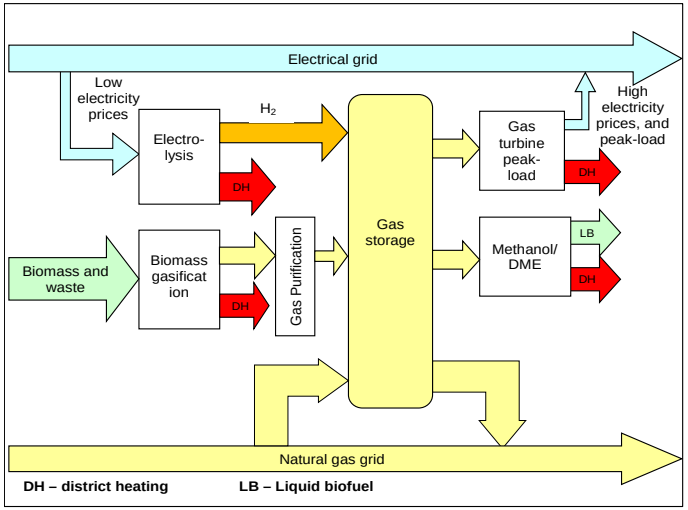


New opportunities for storage

- **Compressed air energy storage**
  - Unique concept of energy storage is salt caverns
  - Expansion into porous reservoir
  - Heat recuperation and combination with renewables (wind farms)

- **Hydrogen storage into gas grids incl. storages**
  - Renewables at off- peak time power electrolysis for H2 production => stored in gas grids incl.storages

- **Others**
  - Temporary storing of flared gas
  - Helium storage
  - Hydrogen storage
  - Carbon capture and storage



Conclusions

- Storage
  - **Inevitable physical instrument** in gas balancing
  - **Commercial and hedging tool**
  - **Proved tool for guarantying SoS**

- Storage **is the most efficient way of energy storage with excellent safety records**

- Storage of gas means **storage of energy** especially by coupling with renewables

- **Innovative storage products coupled with efficient technology** to ensure further impetus for demand on storage capacity and its development

- **There might be demand for further gas storage capacity** and storage industry is ready to address it

Thank you for your attention

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Abbreviations

CIS	Commonwealth of Independent States
H2	Hydrogen
LNG	Liquefied Natural Gas
PGC	Programme Committee
SG	Study Group
SoS	Security of Supply
SSV	Subsurface Safety Valves
UGS	Underground Gas Storage
USA (US)	United States of America
WGC	World Gas Conference
WGV	Working Gas Volume
WOC	Working Committee