

**RECENT DEVELOPMENTS IN THE ENERGY MODEL TIMES-CANADA:
FOCUS ON THE UNCONVENTIONAL GAS PRODUCTION UNTIL 2050**

**Energy and Environment (E2G) Team
GERAD Research Center
Montreal, QC, Canada**

ETSAP Workshop, November 9th, 2011

TIMES-Canada

Regions: 13 provinces and territories

Base year: 2007

Horizon: 2050 (energy)

Horizon: 2100 (climate)

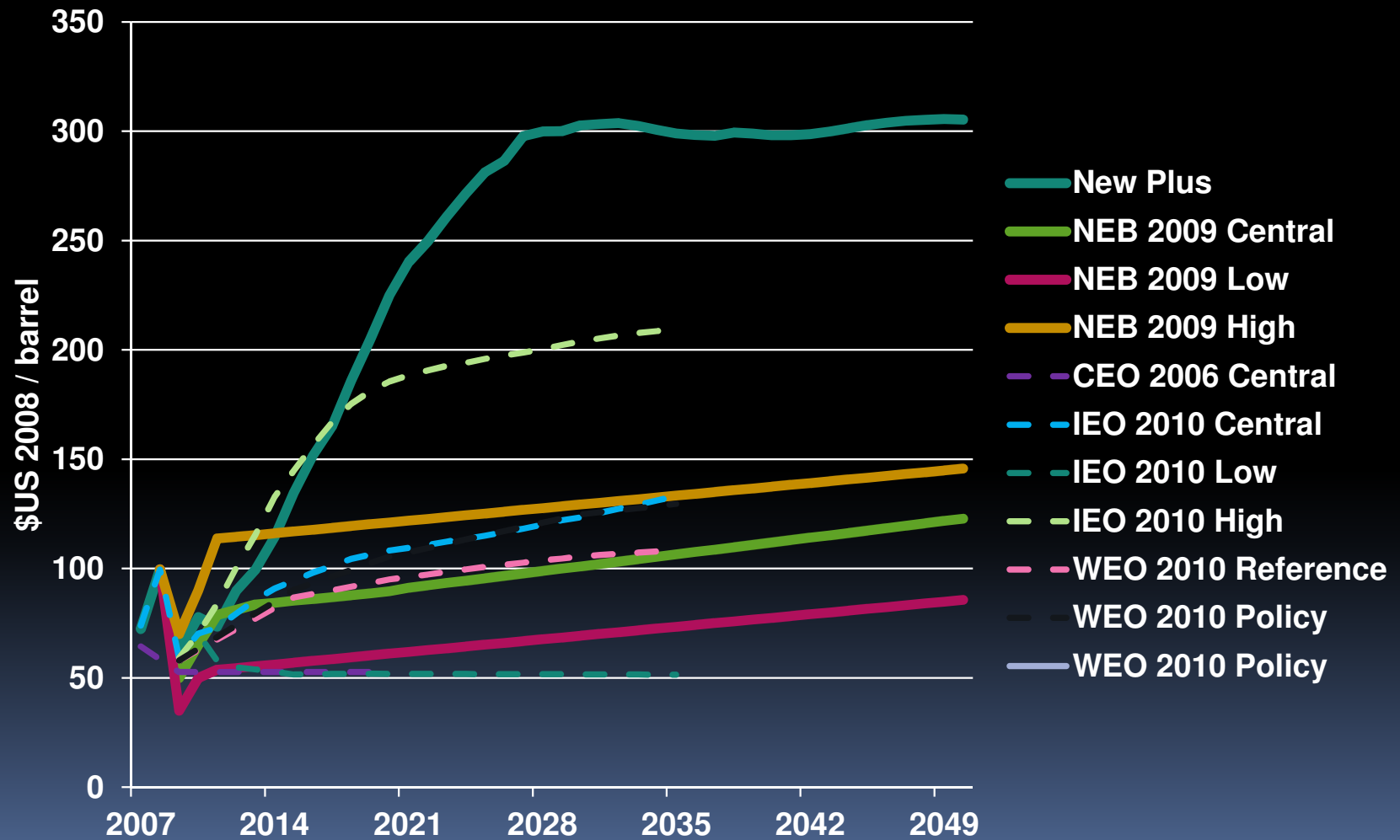


	Start	Mid	End	Length
1	2007	2007	2007	1
2	2008	2008	2009	2
3	2010	2010	2011	2
4	2012	2012	2013	2
5	2014	2015	2017	4
6	2018	2020	2022	5
7	2023	2025	2027	5
8	2028	2030	2032	5
9	2033	2040	2047	15
10	2048	2050	2052	5

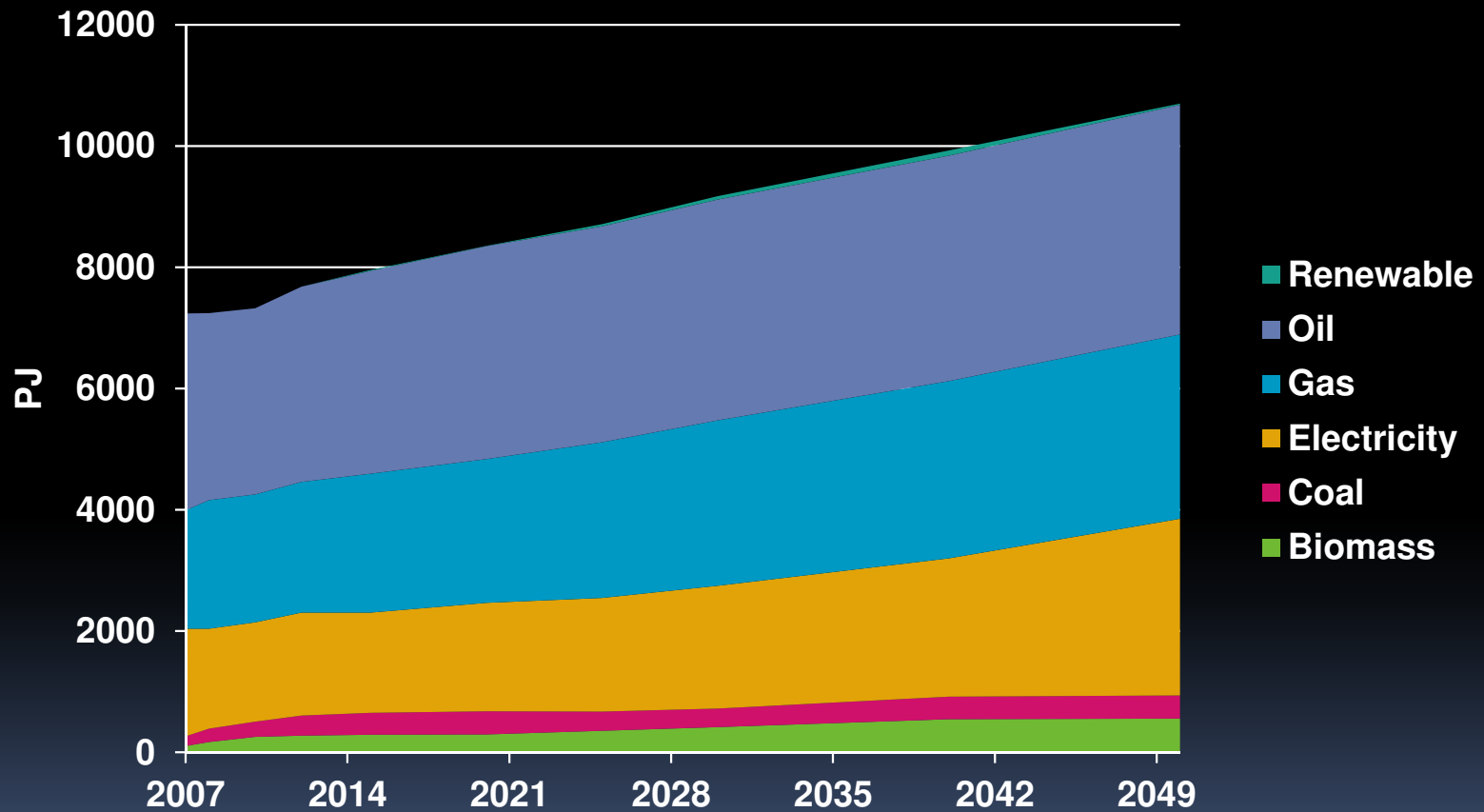
Time slices

- 4 seasons: Spring, Summer, Fall, Winter
- 3 day periods: Day, Night, Peak

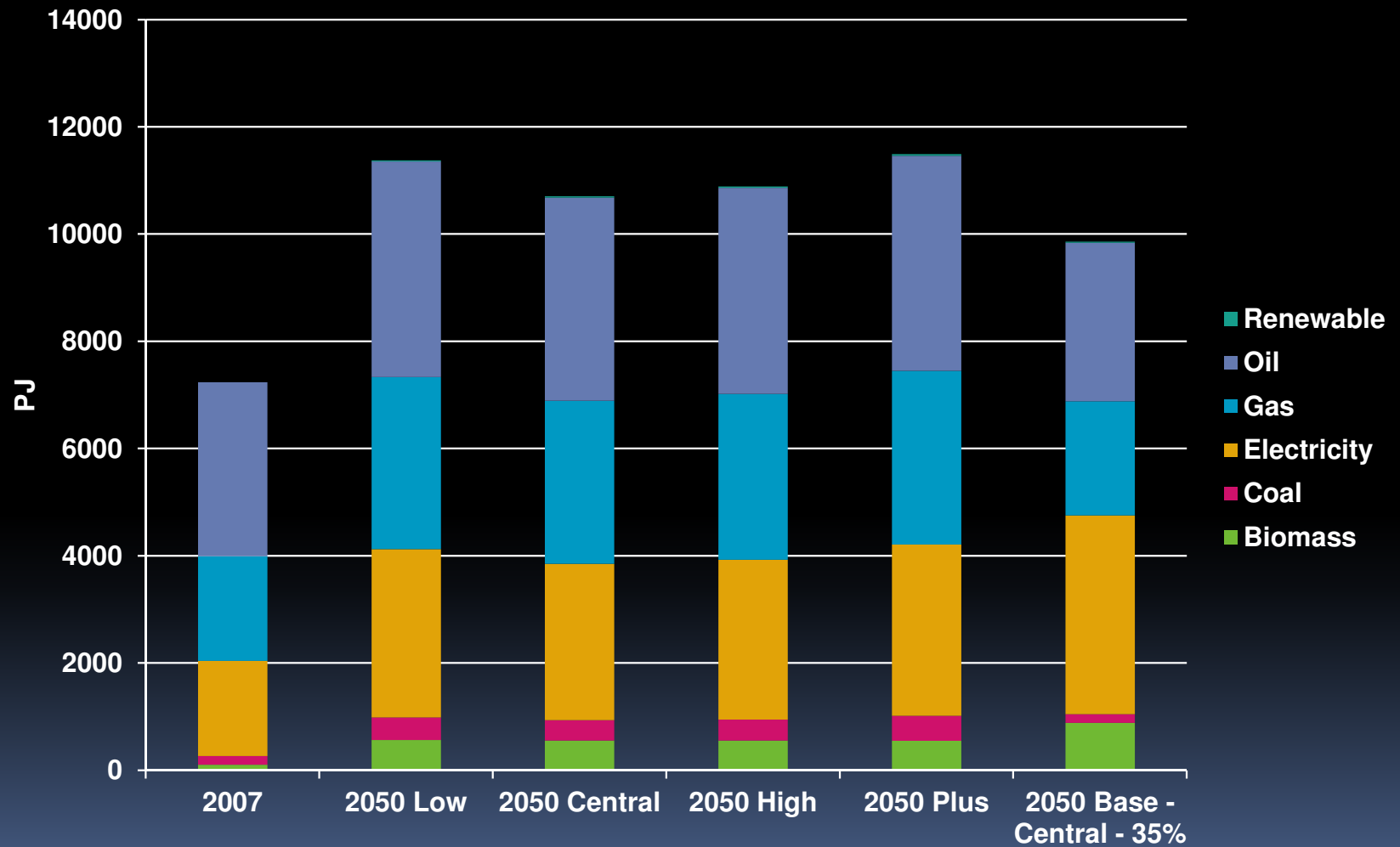
Oil prices for 4 base cases, 2000-2050



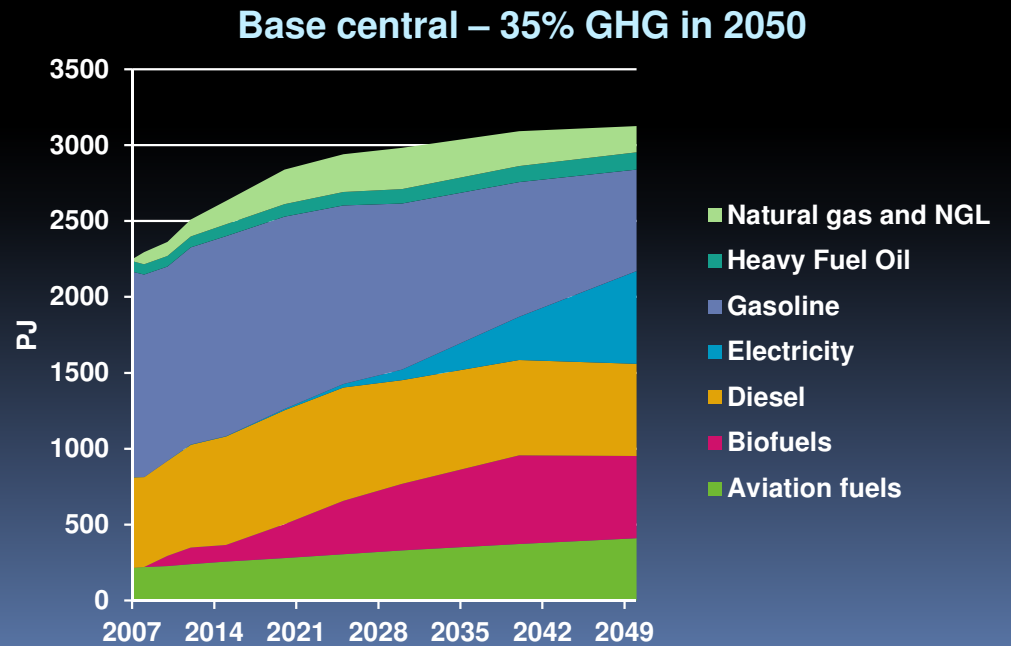
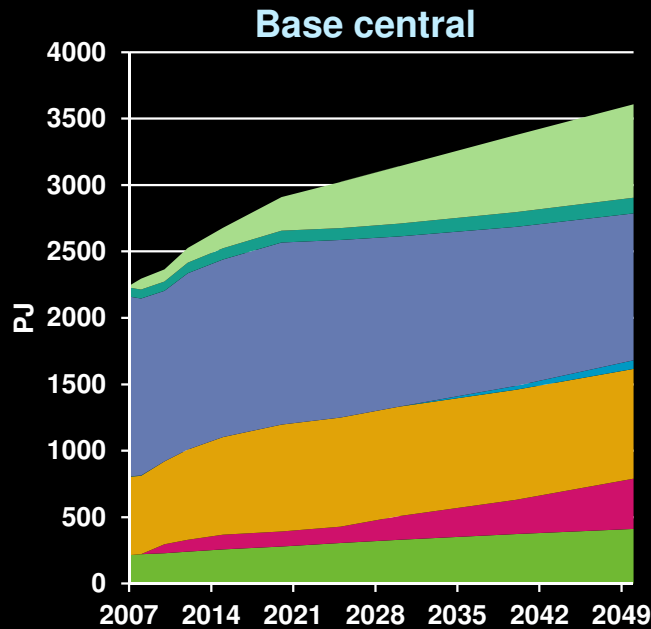
Final energy consumption up to 2050



Final energy consumption in 2050



Fuel consumption in transport up to 2050





CARBON CAPTURE AND SEQUESTRATION (CCS) MODULE

**Thermal Power plants-
Pre-combustion capture**
ECOA*ze, EGAS*ze
ELFO*ze, EHFO*ze

**Thermal Power plants
Post-combustion capture**
ECOA*zo, EGAS*zo
ELFO*zo, EHFO*zo

ELC

ELCCO2N
ELCCH4N
ELCN2ON

ELCSCO2N

CO2 capture
SCAPCHPELC

SINKCO2N

Sink – Enhanced oil recovery
MINSINKEORSTD

SKEORSTD

ELC

CCS – Enhanced oil recovery
SINKEORSTD

OILCRD

Sink – Oil fields onshore
MINSINKOILONS

SKEOILONS

ELC

CCS– Oil fields onshore
SINKOILONS

Sink – Gas fields onshore
MINSINKGASONS

SKEGASONS

ELC

CCS– Gas fields onshore
SINKGASONS

Sink – Oil fields offshore
MINSINKOIOFF

SKEOIOFF

ELC

CCS– Oil fields offshore
SINKOIOFF

Sink – Gas fields offshore
MINSINKGASOFF

SKEGASOFF

ELC

CCS– Gas fields offshore
SINKGASOFF

Sink – CBM recovery < 1000 m
MINSINKCBMLOW

SKECBMLOW

ELC

CCS– CBM recovery < 1000 m
SINKCBMLOW

GASNAT

Sink – CBM recovery > 1000 m
MINSINKCBMHIG

SKECBMHIG

ELC

CCS– CBM recovery > 1000 m
SINKCBMHIG

GASNAT

Sink – Deep saline aquifers
MINSINKAQUIFE

SKEAQUIFE

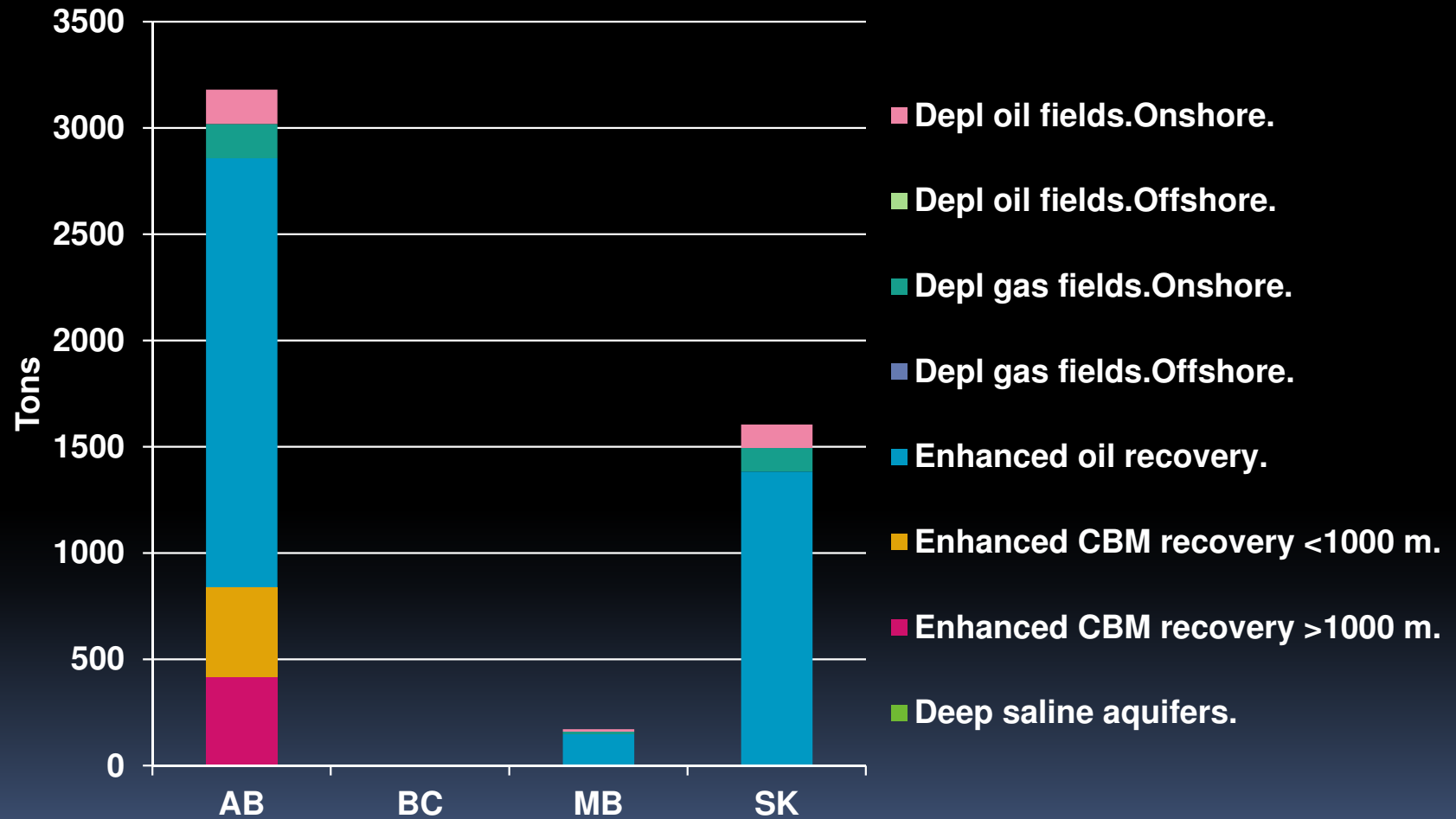
ELC

CCS– Deep saline aquifers
SINKAQUIFE

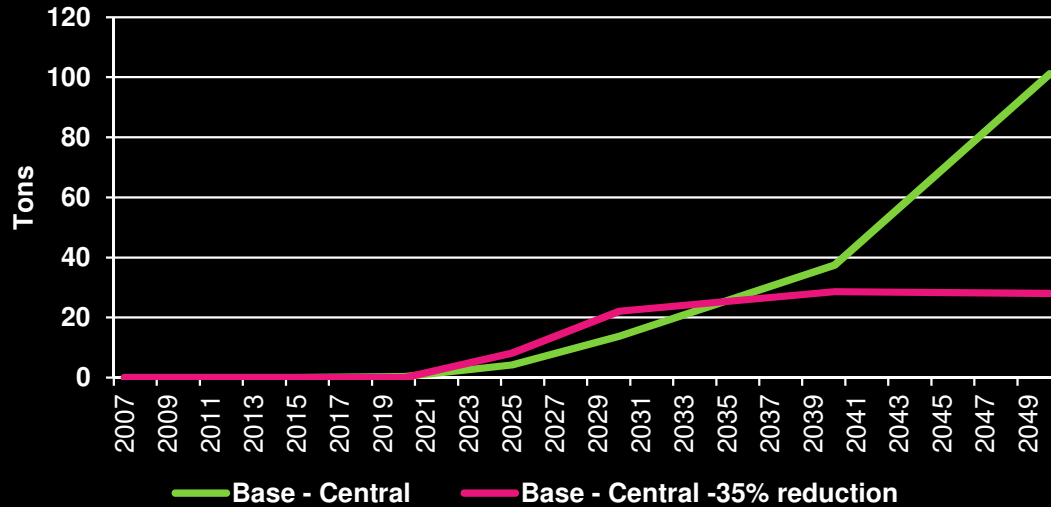
Sink potential

Sequestration

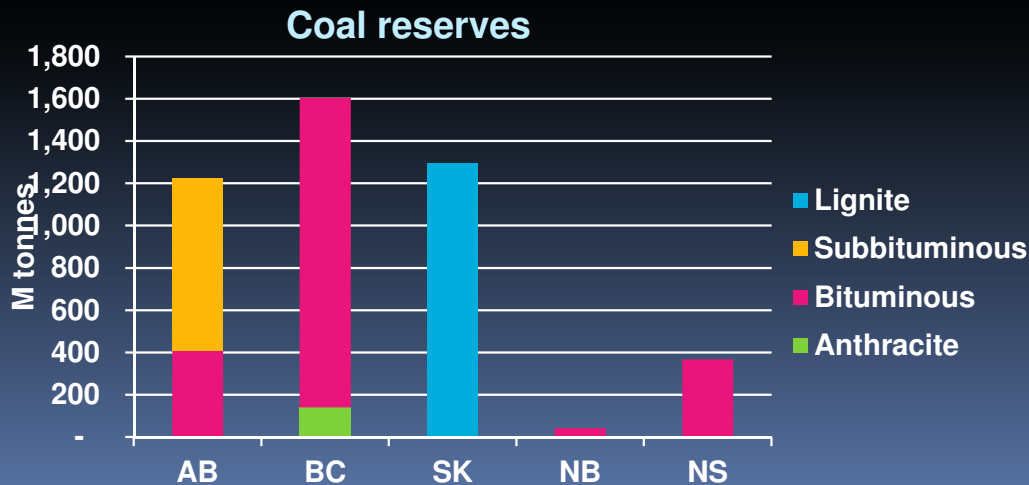
Sink potential in the WEST region



CCS: preliminary results



Base case: Investments in a pulverized coal power plant with CCS for enhanced oil recovery in the WEST
 Constraint: Investments in renewable electricity to reduce GHG emissions



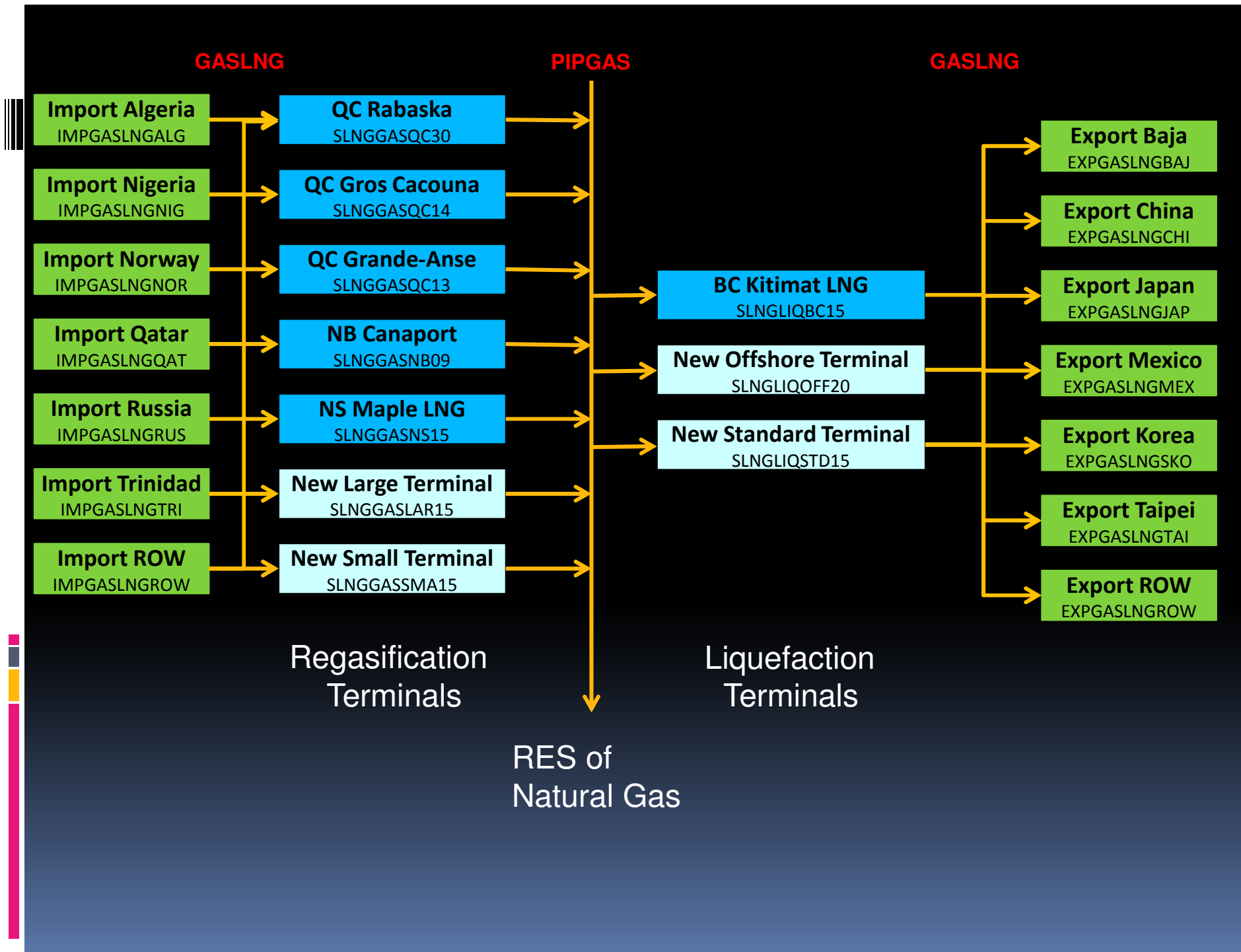
Need to review

- Investment growth in renewable power
- Coal trade between provinces

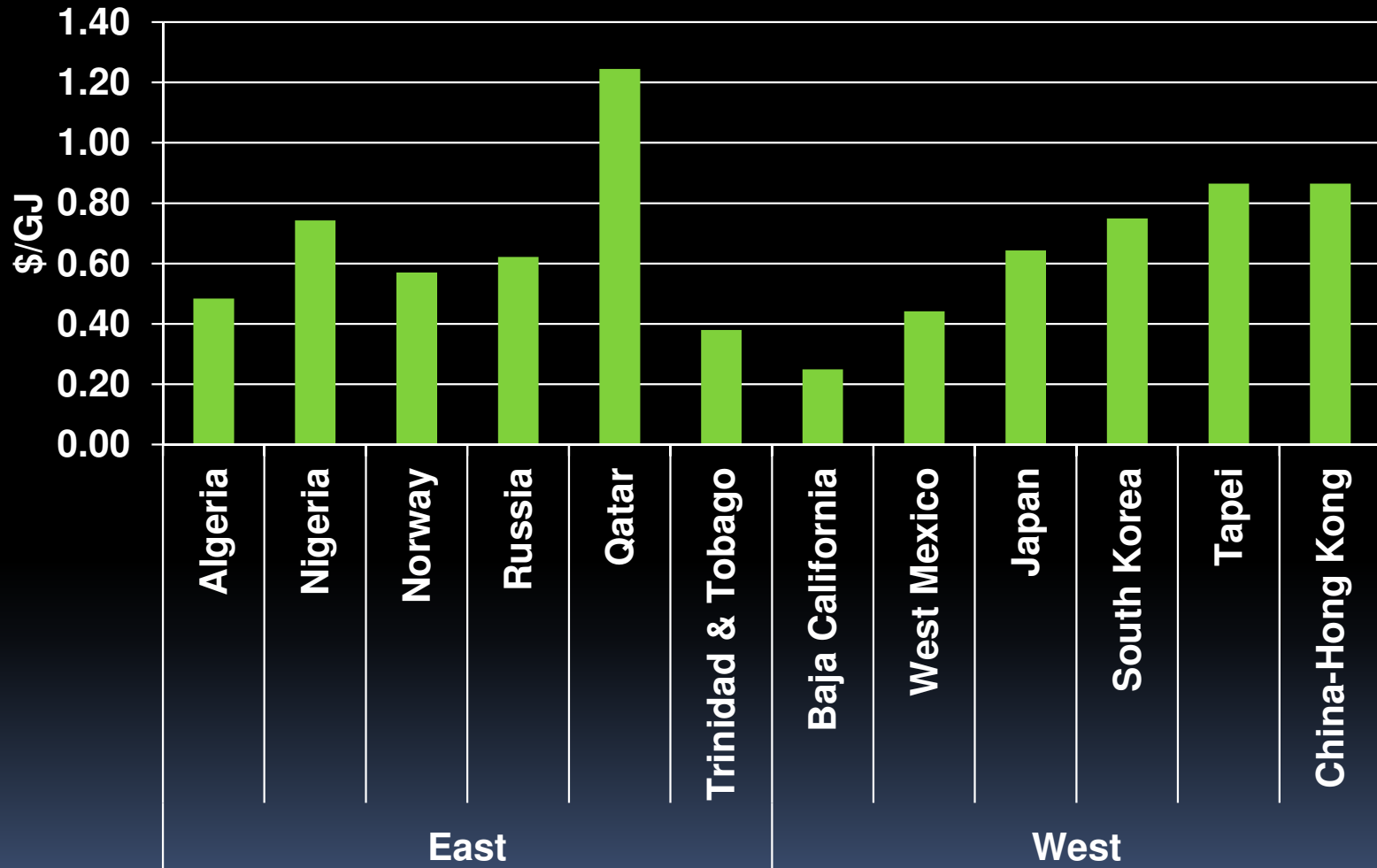


LIQUEFIED NATURAL GAS (LNG) MODULE

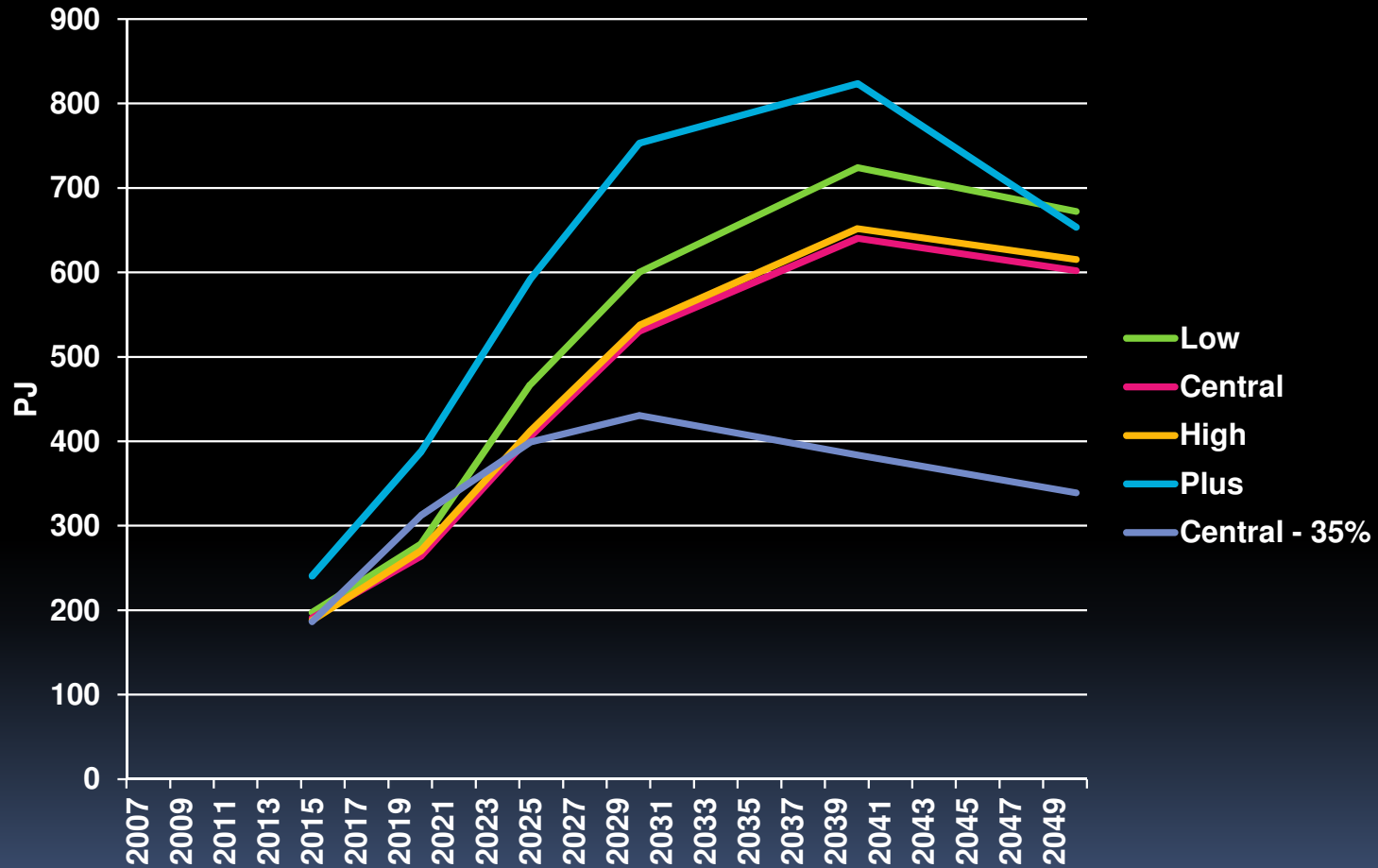




LNG import costs between 2007-2010



LNG imports: preliminary results





UNCONVENTIONAL GAS MODULE



**Coal Bed Methane -
Located Reserves**
MINRSVCBM1,2,3

RSVCBM

**Coal Bed Methane -
Production**
SPRIRSVCBM1

**Coal Bed Methane -
Additional Reserves**
MINRSVCBM7,8,9

**Coal Bed Methane -
Production Add**
SPRIRSVCBM2

**Shale Gas -
Additional Reserves**
MINRSVSHA1,2,3

RSVSHA

**Shale Gas -
Production**
SPRIRSVSHA1

**Shale Gas -
Additional Reserves**
MINRSVSHA7,8,9

**Shale Gas -
Production Add**
SPRIRSVSHA2

**Tight Gas -
Located Reserves**
MINRSVTIG1,2,3

RSVTIG

**Tight Gas -
Production**
SPRIRSVTIG1

**Tight Gas
Additional Reserves**
MINRSVTIG7,8,9

**Tight Gas -
Production**
SPRIRSVTIG2

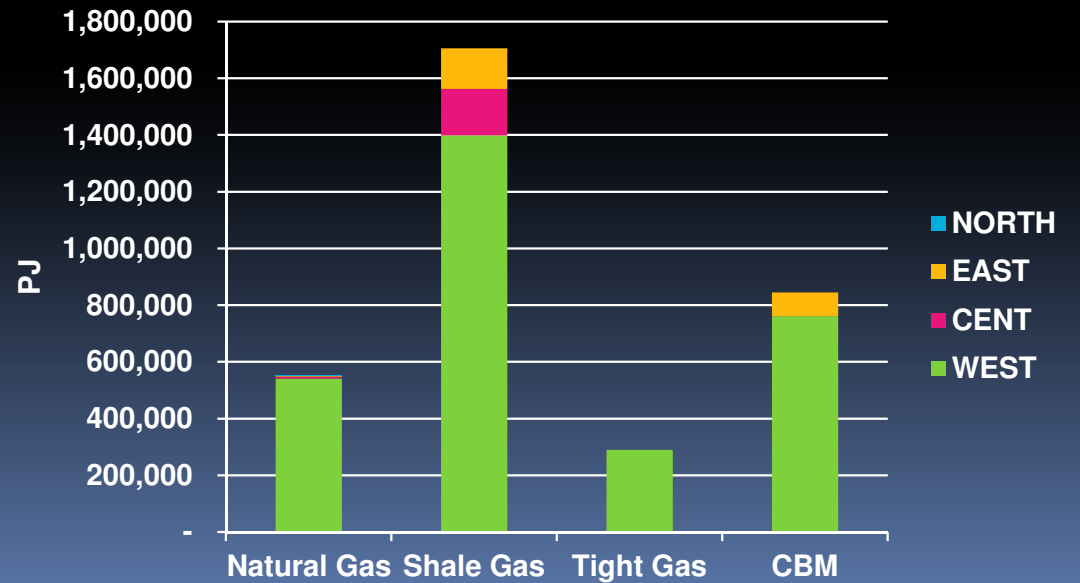
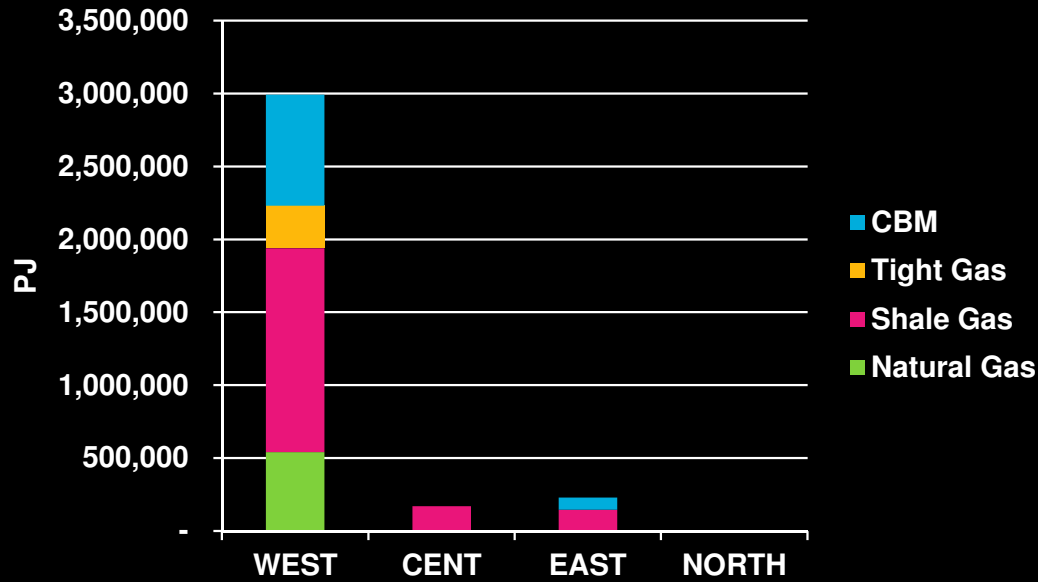
OILNGL

GASNAT

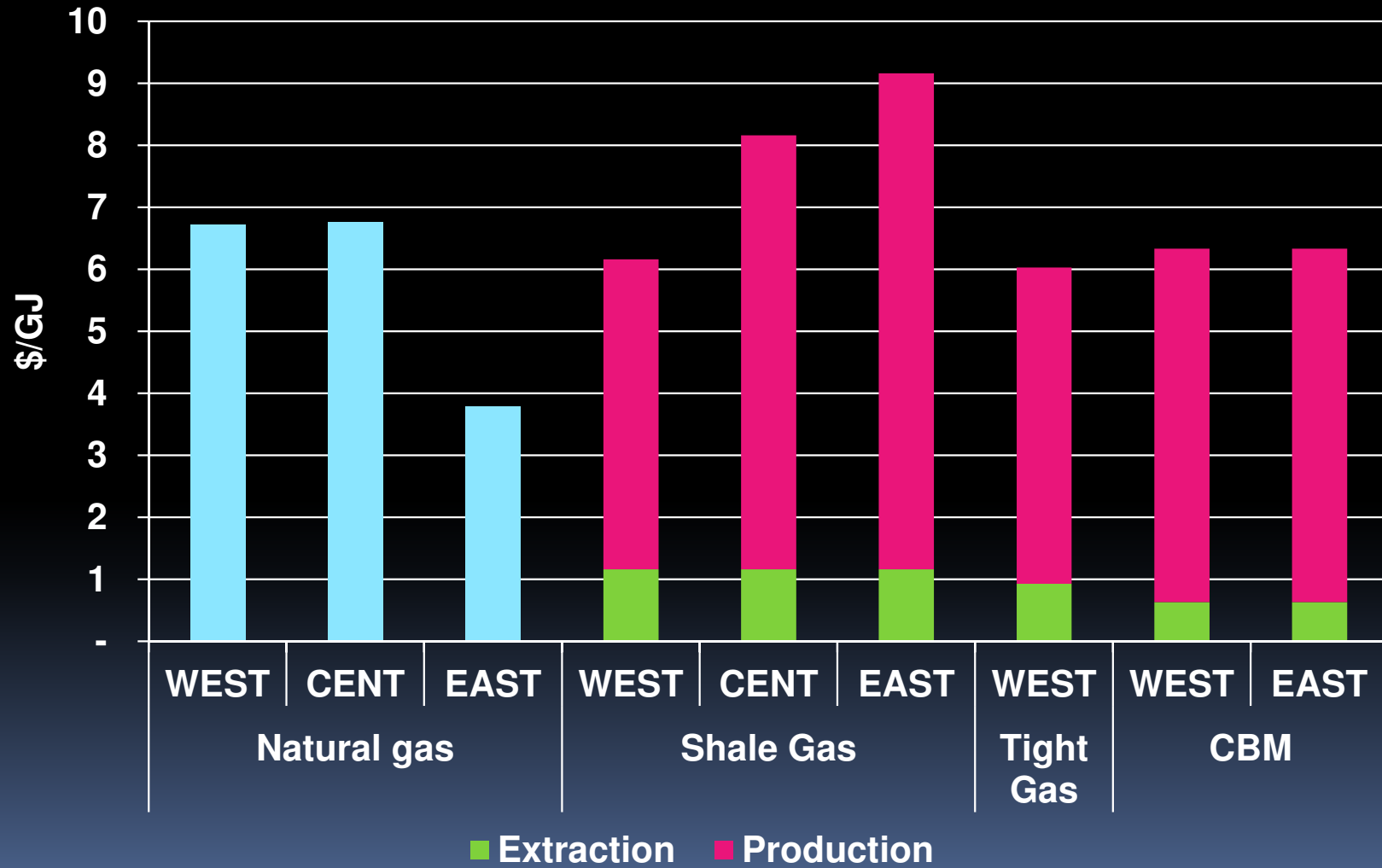
Natural Gas Pipeline
SPIPGAS

PIPGAS

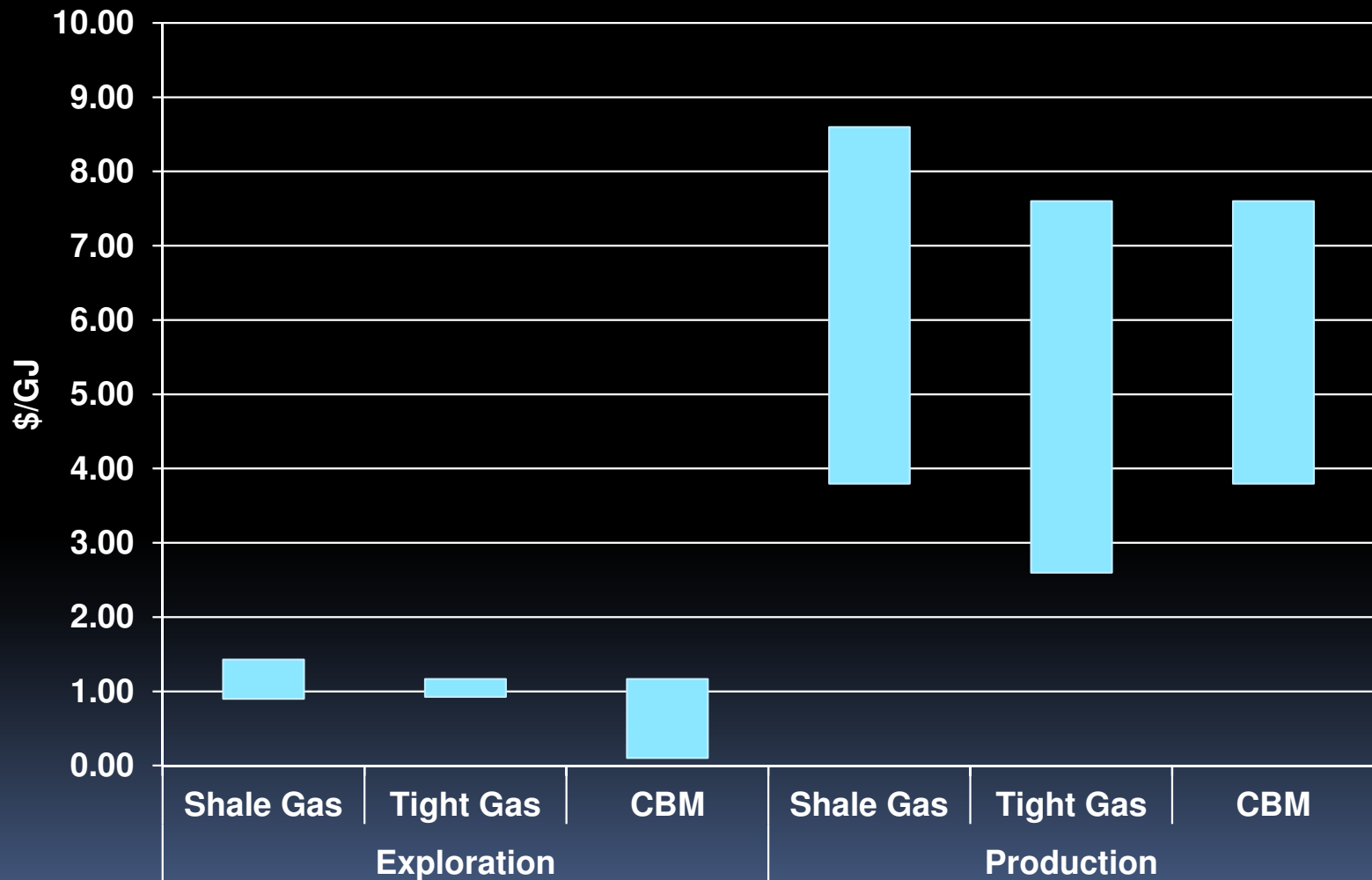
Cumulative gas reserves



Gas extraction and production costs



Gas extraction and production costs: Ranges

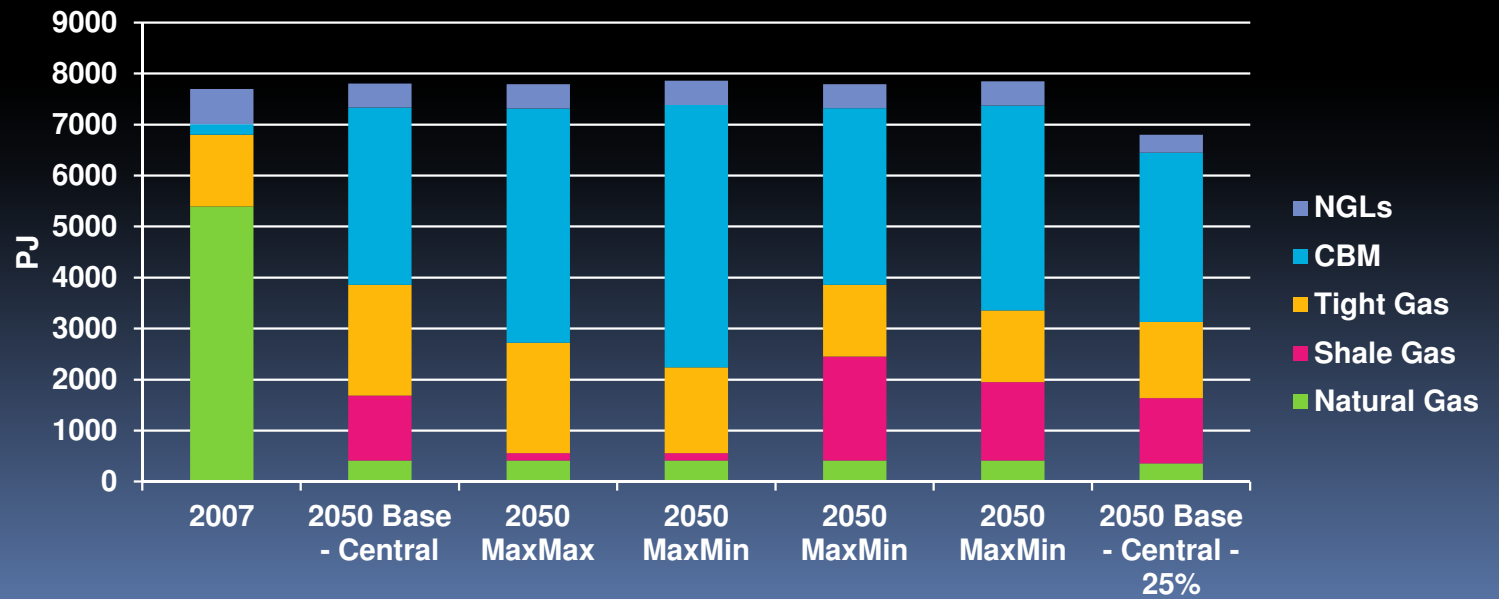
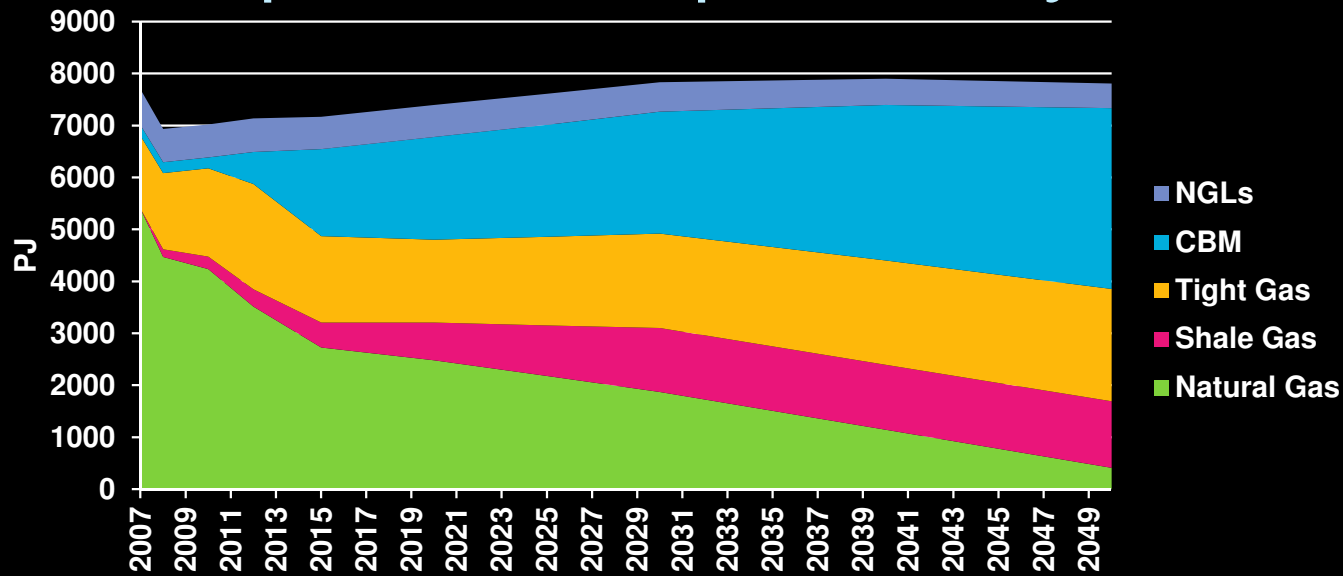


Gas production scenarios

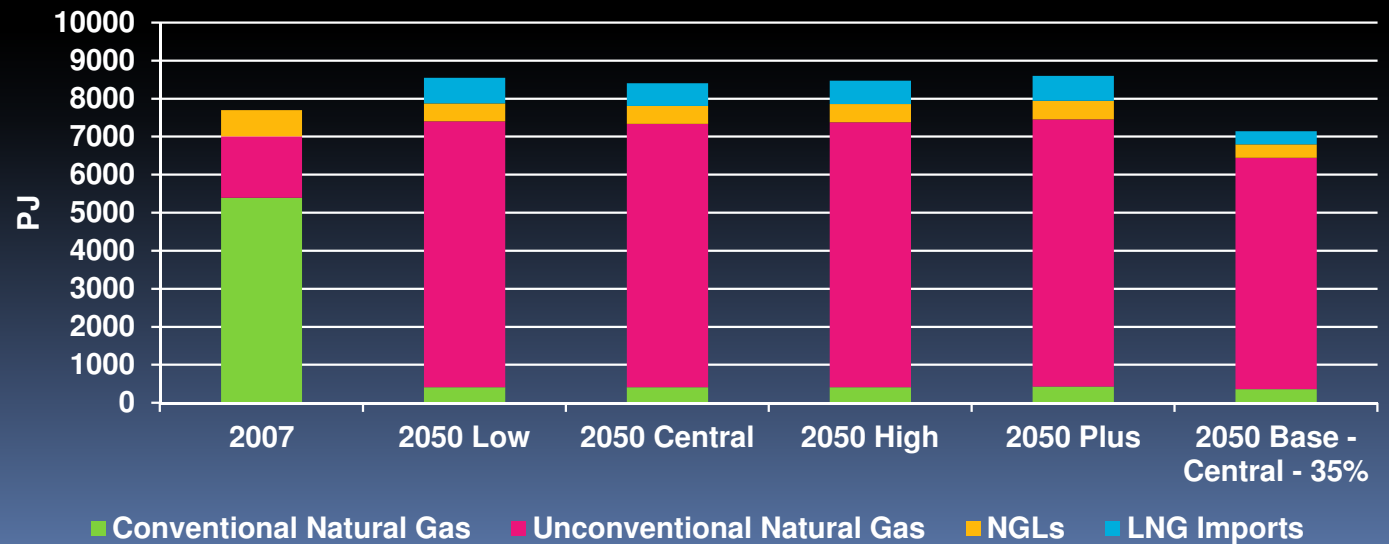
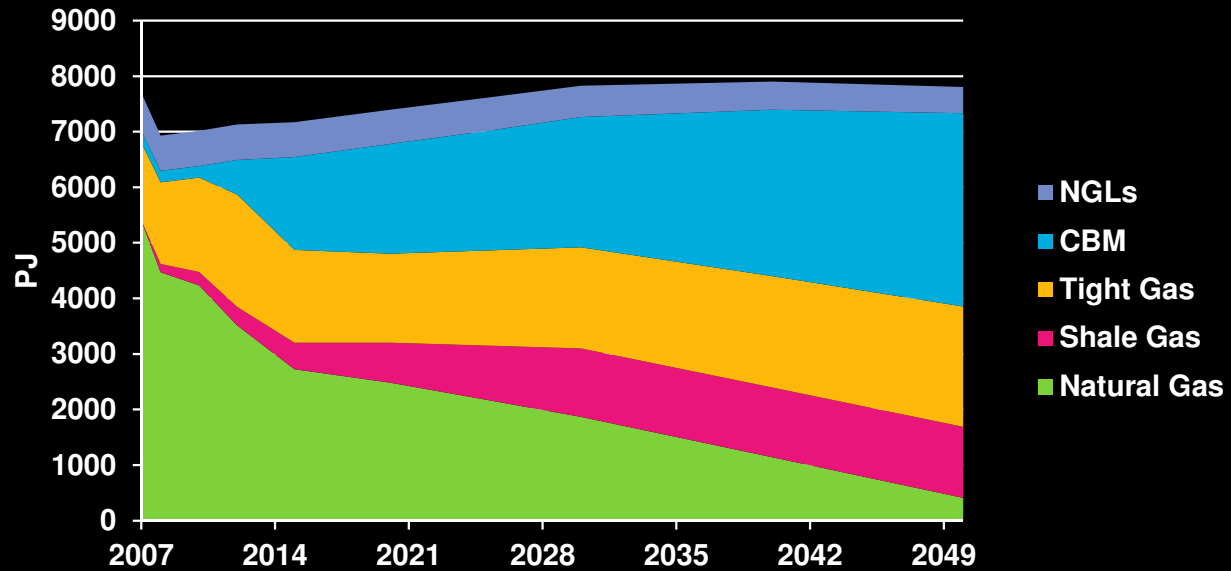
- Reference: Central case
- Alternate cases

	Shale gas	CBM
A	Min	Min
B	Min	Max
C	Max	Max
D	Max	Min

Gas production : preliminary results



Gas production : preliminary results



Work in progress

Model developments

- Demand projections up to the 2100 horizon (IPCC scenarios)
- Process GHG emissions and CAC emissions
- CCS in industries
- Energy corridors and coupling with the TIAM world model

Sensitivity analysis

- Renewable power versus CCS
- Unconventional oil and gas production
- LNG imports
- Biomass potential and conversion (next generation)
- Hydrogen production

Thank you from the team

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