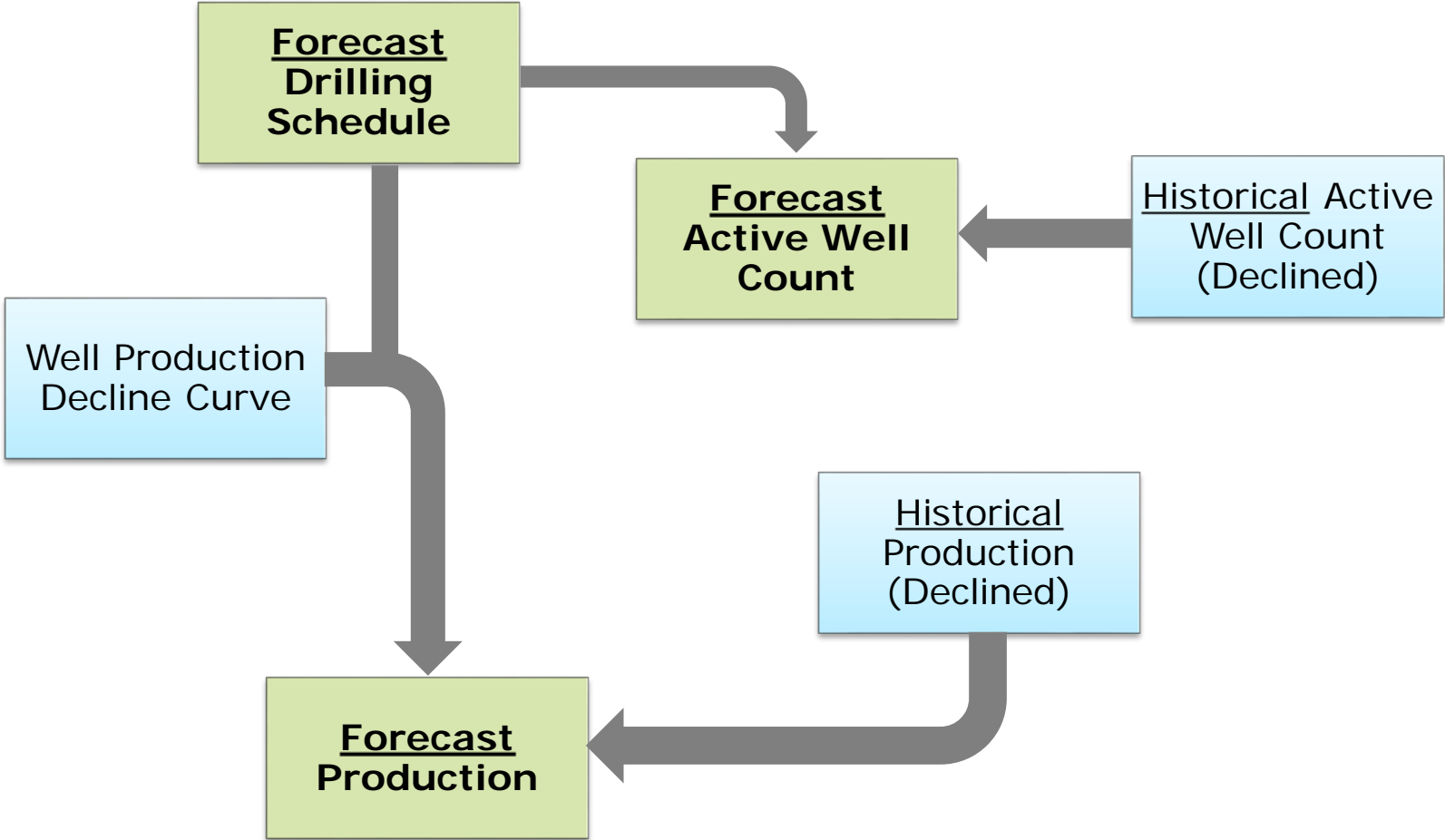




O&G EMISSION INVENTORY FORECAST METHODOLOGY

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Ramboll Environ

BASIN-LEVEL O&G ACTIVITY FORECAST CONCEPT



BASIN-LEVEL METHOD OUTLINE

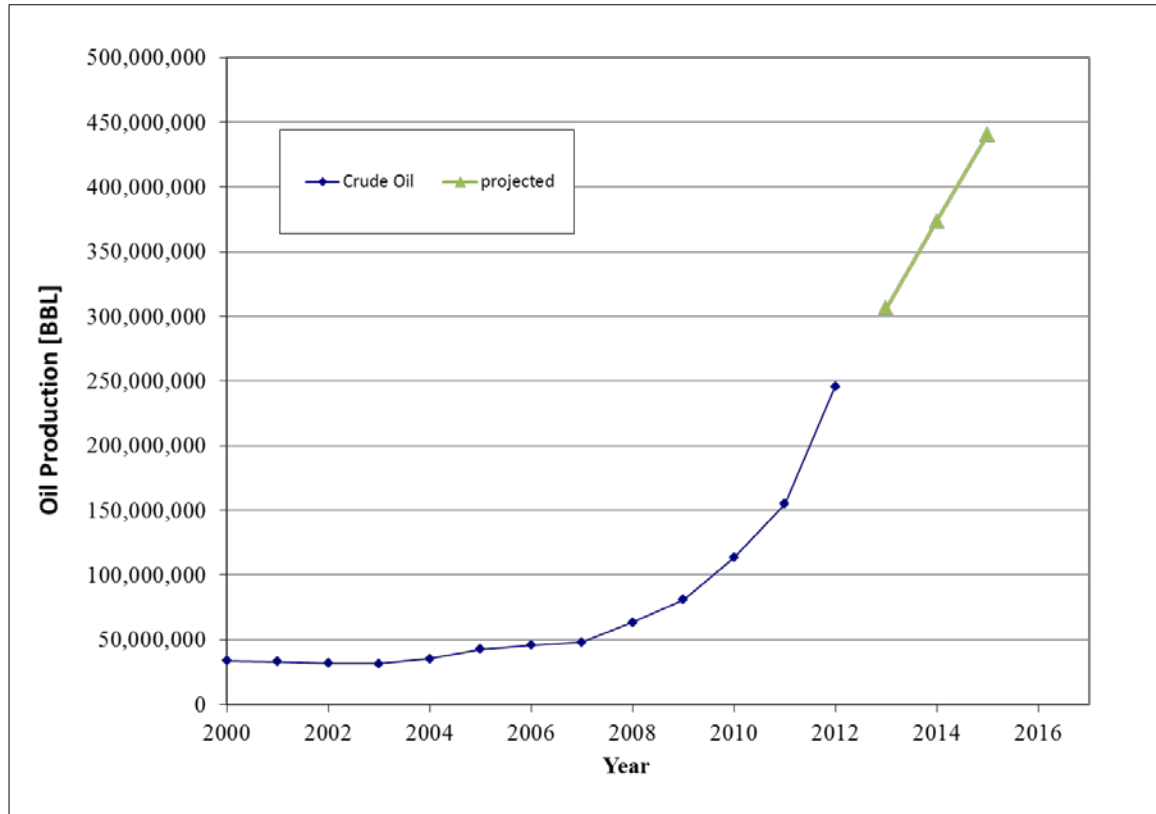
- O&G Activity Forecast
 - Tailored: Depends on data available
- O&G Controls
 - Local/state/federal programs
 - “New source” vs. “all source” standards
 - Control effects determined by base and future year assumptions

Sample O&G Activity Forecast Methods

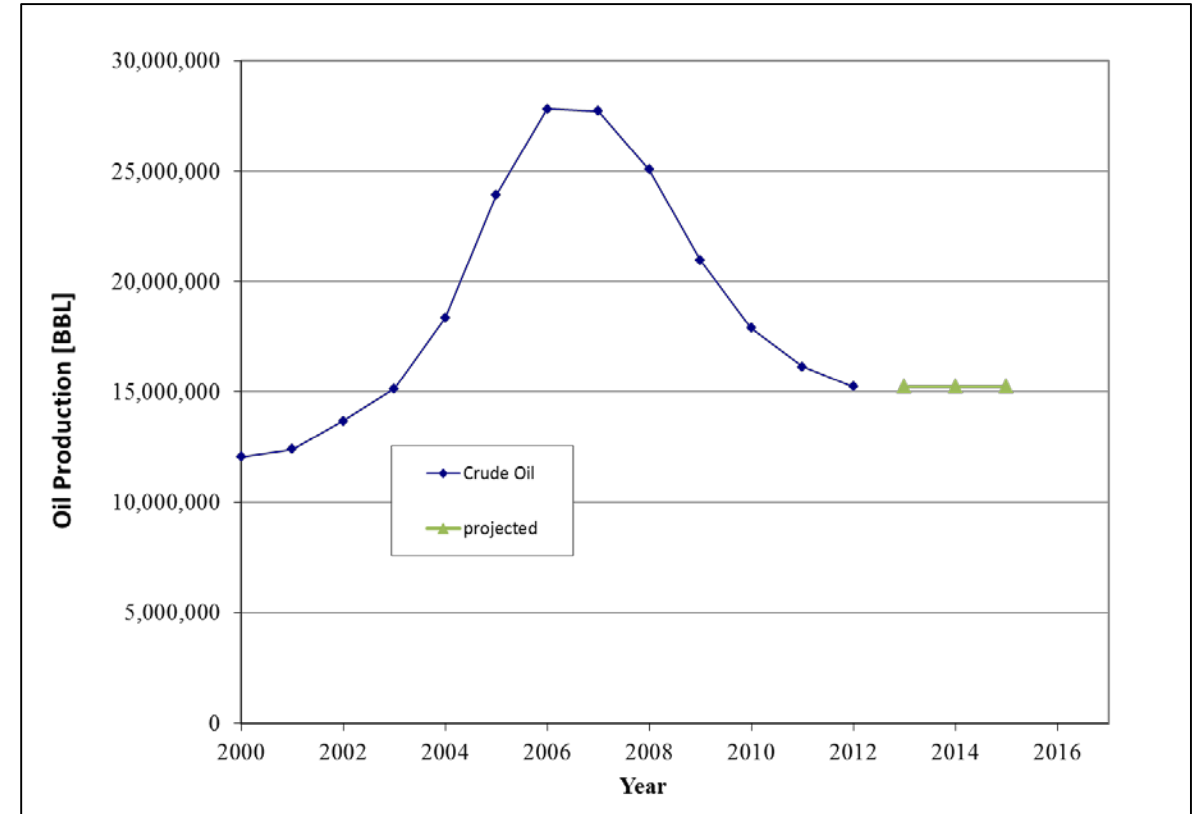
<i>If available</i>	3 rd Party O&G Activity Forecast Study -e.g., Williston Basin, WRAP Phase III Denver Basin
	NEPA Forecast + Historical Trends -e.g., Great Plains Basin, several WRAP Phase III Basins
	Historical Trends w/ basin specific decline -WRAP Phase III Uinta, Wind River, and Piceance Basins
	Historical Trends w/ Production to meet LNG Facility Buildouts -Northeast Texas
<i>Default</i>	Historical Trends -e.g., Great Plains Basin, several WRAP Phase III Basins
	EIA Forecast -e.g., Permian Basin

ACTIVITY FORECAST EXAMPLE: WILLISTON BASIN

Bakken Subarea



Cedar Creek Subarea



CONTROL METHOD MATRIX

Table 5-8. Controls summary by emission category.

Source Category	Well Type	2011*	2015
Drill Rigs, Fracing Engines, Workover Rigs	oil wells	NONROAD default 2011 emission rates	NONROAD default 2015 emission rates
	gas wells		
Initial Completions	oil wells	99% green completions, 1% conventional completions	assumed unchanged from 2011
	gas wells	71% green completions, 29% conventional completions	
Water Tanks	oil wells	64% controlled, 36% uncontrolled	assumed unchanged from 2011
	gas wells		
Condensate Tanks	gas wells	ND&SD: 13% controlled, 87% uncontrolled, MT: 98% controlled, 2% uncontrolled	assumed unchanged from 2011
Oil Tanks	oil wells	10% uncontrolled, 90% controlled (70% by flare, 13% by VRU, and 6% by enclosed combustor)	ND&SD: 100% controlled (79% by flare, 14% by VRU and 7% by enclosed combustor) MT*: 2% uncontrolled, 98% controlled (79% by flare, 13% by VRU and 6% by enclosed combustor)
Casinghead Gas	oil wells	37% of casinghead gas flared	25% of casinghead gas flared
Oil Well Truck Loading	oil wells	<u>survey-based</u> 31% of oil sent directly to pipeline, 70% loaded to truck (100% submerged loading) <u>tribal minor source registration-based</u> 54% of oil sent directly to pipeline, 36% loaded to truck (100% submerged loading)	assumed unchanged from 2011
Gas Well Truck Loading	gas wells	0% of condensate sent directly to pipeline, 100% submerged loading	assumed unchanged from 2011
Rail Loading	oil wells	100% submerged loading	assumed unchanged from 2011

Source Category	Well Type	2011*	2015
Artificial Lift Engines	oil wells	Average emission rates greater than NSPS JJJJ standards based on survey-based and registration-based data	Engines added after 2011 emission rates conform to NSPS JJJJ standards
Fugitive Components	oil wells	no control	assumed unchanged from 2011
	gas wells		
Heaters	oil wells	no control	assumed unchanged from 2011
	gas wells		
Pneumatic Devices	oil wells	24% high bleed, 39% intermediate bleed, and 38% low bleed	Devices added after 2011 are low bleed devices per NSPS OOOO standards
	gas wells	47% high bleed, 41% intermediate bleed, and 12% low bleed	
Pneumatic Pumps	oil wells	uncontrolled	assumed unchanged from 2011
	gas wells		
Dehydrators	oil wells	60% uncontrolled, 20% controlled by flare, 20% controlled by closed-loop system	assumed unchanged from 2011
	gas wells	67% uncontrolled, 33% controlled by flare	
Wellhead Compressor Engines	oil wells	interim NSPS JJJJ emission standards	assumed unchanged from 2011
	gas wells	interim NSPS JJJJ emission standards	
Miscellaneous Engines	oil wells	emission rates based on survey and tribal minor source registrations	assumed unchanged from 2011
	gas wells	uncontrolled	
Well Blowdowns	oil wells	100% controlled by flare	assumed unchanged from 2011
	gas wells	100% uncontrolled	
Midstream Sources	not applicable	no control	assumed unchanged from 2011

* For production added in time periods subject to NSPS OOOO (as listed in Table 5-7). Production added in periods not subject to NSPS OOOO remain controlled at 2011 levels.

CONTROL METHOD EXAMPLE WILLISTON OIL TANKS

- Base year control prevalence (survey-based)
- Future year control prevalence based on expected implementation of state and federal regulations
- Future year emissions decreases commensurate with changes in both O&G activity and controls

State	2011		Growth	2015	
	Survey-based Control Prevalence	Emissions (tpy)		Regulation-based Control Prevalence	Emissions (tpy)
MT	90%	8,610	166%	90%	14,392
ND & SD		65,901		100%	26,236

* Control efficiency changes from 2011 to 2015 not shown above

ADDITIONAL INFORMATION

January 11, 2017 Presentation to NOGEC:
[O&G PROJECTIONS USED IN NEPA AND REGIONAL O&G INVENTORY STUDIES](#)