ATC Stakeholder Update
2019 Futures Matrix Review

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ATC 2019 Futures Matrix

Drivers	Load Growth within ATC	Energy Growth within ATC	Load Growth outside ATC	Energy Growth outside ATC	Total Small Capacity Coal Retirements (or conversions to natural gas) Within ATC	Generator Additions Within ATC
Bounds	2019	2019	2019	2019	2019	2019
Lower	0.2%	0.1%	N/A	N/A	907 MW	Planned Wind Plus 2,250 MW
Mid[3]	1.40%	1.10%	1.21%	1.07%	453 MW	Planned Wind Plus 3,750 MW
Upper	2.5%	2.2%	N/A	N/A	Announced (289 MW)	Planned Wind Plus 3,750 MW
2019 Futures Descriptions						
Robust Economy	2.50%	2.20%	1.21%	1.07%	Upper	Mid
High Retirements	1.20%	0.90%	1.21%	1.07%	Lower	Mid
High Environmental	0.70%	0.50%	1.21%	1.07%	Lower	Mid
Slow Growth	0.20%	0.10%	1.21%	1.07%	Mid	Lower
DOE 20% Wind	1.70%	1.40%	1.21%	1.07%	Lower	Upper
Fuel & Inv. Limitations	1.00%	0.70%	1.21%	1.07%	Mid	Mid

Drivers	Percent Energy from Wind for Units Sited Inside ATC	Natural Gas Price Forecast	Coal Price Forecast for New Units	Environmental Regulations	Wind Power from the RGOS/UMTDI Study Inside SD, ND, MN, IA and WI (GW)	RGOS/UMTDI Transmission Overlay & Generation Portfolio Outside ATC
Bounds	2019	2019	2019	2019	2019	2019
Lower	11%	-40%	-10%	\$0/ton for CO_2, 0% higher mercury costs	15	See Below
Mid[3]	16%	NYMEX for as many years as available followed by EIA escalation rate.	MISO Central & West \$2.03 & \$1.71 per MMBTU, respectively, for 2019.	\$25/ton for CO_2, 25% higher mercury costs	25	See Below
Upper	16%	50%	20%	\$44/ton for CO_2, 25% higher mercury costs	45	See Below
2019 Futures Descriptions						
Robust Economy	Mid	Mid-Upper +25%	Upper	Low	25 GW	765KV Overlay Reference
High Retirements	Mid	Mid-Low -20%	Mid	Mid	25 GW	345kV Overlay Reference
High Environmental	Upper	Upper	Lower	Upper	45 GW	345kV Overlay Gas-only
Slow Growth	Lower	Lower	Mid	Low	15 GW	345kV Overlay Reference
DOE 20% Wind	Upper	Mid	Lower	Mid	45 GW	765kV Overlay Reference
Fuel & Inv. Limitations	Mid	Mid-Upper +25%	Mid	Mid	25 GW	345kV Overlay Gas-only

2019 Load & Energy Growth

2019 Future	Inside ATC Peak Demand Growth (%)	Outside ATC Peak Demand Growth* (%)
Reference	1.40%	~1.21%
Robust Economy	2.50%	~1.21%
High Retirements	1.20%	~1.21%
High Environmental	0.70%	~1.21%
Slow Growth	0.20%	~1.21%
20% Wind	1.70%	~1.21%
Fuel & Investment Limitation	1.00%	~1.21%

2019 Future	Inside ATC Energy Growth (%)	Outside ATC Energy Growth* (%)
Reference	1.10%	~1.07%
Robust Economy	2.20%	~1.07%
High Retirements	0.90%	~1.07%
High Environmental	0.50%	~1.07%
Slow Growth	0.10%	~1.07%
20% Wind	1.40%	~1.07%
Fuel & Investment Limitation	0.70%	~1.07%

*Outside ATC Peak Demand and Energy Growth includes all non-ATC MISO companies

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2019 Small Coal Capacity Retirements within ATC

2019 Future	Small Capacity Coal Retirements Within ATC (MW)
Reference	453
Robust Economy	Announced (289)
High Retirements	907
High Environmental	907
Slow Growth	453
20% Wind	907
Fuel & Investment Limitation	453

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2019 Planned Generator Additions within ATC

- All futures include Weston 4 and Elm Road 1 and 2
- All futures include the following Wind Generation:
  - 439.2 MW In-Service prior to end of 2009
  - 538.5 MW In-Service after 2009*

*New generation is based on wind power plants that have a signed Interconnection Agreement (IA) and are not in suspension as of June 30, 2009

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2019 MISO Expansion Generation within ATC

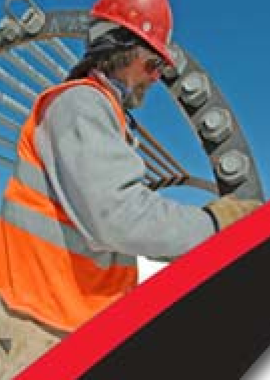
Non-renewable additions:

	MISO Generator Additions within ATC (MW)		
2019 Future	**CT***	**Coal****	**Combined Cycle*****
Reference	600	600	0
Robust Economy	600	600	0
High Retirements	600	600	0
High Environmental	600	0	600
Slow Growth	600	600	0
20% Wind	600	600	0
Fuel & Investment Limitation	600	0	600

*600 MW CT added in 2013

**600 MW Coal Unit added in 2016

***600 MW Combined Cycle Unit added in 2016 (substituted for coal in Gas-Only Future)



2019 MISO Expansion Generation within ATC

Wind additions:

	MISO Generator Additions within ATC (MW)	ATC Total Generation: MISO Expansion + Planned (MW)
2019 Future	**Wind***	**Wind**
Reference	3,750	4,728
Robust Economy	3,750	4,728
High Retirements	3,750	4,728
High Environmental	3,750	4,728
Slow Growth	2,250	3,228
20% Wind	3,750	4,728
Fuel & Investment Limitation	3,750	4,728

*MISO Wind additions based on UMTDI Scenario B and include 3 WI Energy Zones:

-750 MW each in MISO's RGOS 15 GW Model (2,250 Total MW)

-1,250 MW each in MISO's RGOS 25 GW Model (3,750 Total MW)

2019 % Energy in ATC from Renewables & Total UMTDI Wind

2019 Future	ATC % Energy from Wind	Total UMTDI Wind (GW)*
Reference	16%	25
Robust Economy	16%	25
High Retirements	16%	25
High Environmental	16%	45**
Slow Growth	11%	15
20% Wind	16%	45**
Fuel & Investment Limitation	16%	25

*Total Wind Generation from UMTDI Corresponds to units added in: Iowa, Minnesota, North Dakota, South Dakota, and Wisconsin.

**The 45 GW Case corresponds to a 20% Wind Renewable Portfolio Standard MISO-wide. Timelines and development of this case are currently uncertain.

2019 Natural Gas Price Forecast

2019 Natural Gas Price Forecasts for the Reference Case are based on NYMEX natural gas values

	2019 Natural Gas Price Forecast ($/MMBtu)											
2019 Future	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Reference	8.88	8.88	8.65	7.89	7.86	7.94	8.03	8.09	8.11	8.19	8.48	8.80
Robust Economy	11.10	11.10	10.81	9.87	9.82	9.92	10.03	10.11	10.13	10.24	10.60	11.00
High Retirements	7.11	7.10	6.92	6.31	6.29	6.35	6.42	6.47	6.49	6.55	6.79	7.04
High Environmental	13.32	13.32	12.97	11.84	11.79	11.91	12.04	12.13	12.16	12.29	12.72	13.20
Slow Growth	5.33	5.33	5.19	4.74	4.71	4.76	4.82	4.85	4.86	4.92	5.09	5.28
20% Wind	8.88	8.88	8.65	7.89	7.86	7.94	8.03	8.09	8.11	8.19	8.48	8.80
Fuel & Investment Limitation	11.10	11.10	10.81	9.87	9.82	9.92	10.03	10.11	10.13	10.24	10.60	11.00

2019 Coal Price Forecast for New Units

- 2019 Coal Price Forecasts are equivalent to those used by MISO
- These values apply to new MISO expansion plan coal generators
- Any new ATC coal generators from the MISO expansion will use MISO Central Coal prices

	2019 Coal Price Forecast ($/MMBtu)			
2019 Future	**MISO East**	**MISO Central**	**MISO West**	**MRO**
Reference	2.32	2.03	1.71	1.71
Robust Economy	2.78	2.44	2.05	2.05
High Retirements	2.32	2.03	1.71	1.71
High Environmental	2.09	1.83	1.53	1.53
Slow Growth	2.32	2.03	1.71	1.71
20% Wind	2.09	1.83	1.53	1.53
Fuel & Investment Limitation	2.32	2.03	1.71	1.71

2019 Environmental Regulations

2019 Future	CO2 Adder ($/ton)	Mercury Adder (%)
Reference	25	25% Higher
Robust Economy	0	0% Higher
High Retirements	25	25% Higher
High Environmental	44	25% Higher
Slow Growth	0	0% Higher
20% Wind	25	25% Higher
Fuel & Investment Limitation	25	25% Higher

2019 MISO RGOS Generation & Transmission Portfolios Outside ATC

ATC started with the MISO RGOS Futures as a base point for developing the ATC Futures

2019 Future	Base MISO Generation	Base MISO Transmission
Reference	Reference	345 kV Overlay (25 GW)
Robust Economy	Reference	765 kV Overlay (25 GW)
High Retirements	Reference	345 kV Overlay (25 GW)
High Environmental	Gas Only	345 kV Overlay (45 GW)*
Slow Growth	Reference	345 kV Overlay (15 GW)
20% Wind	Reference	765 kV Overlay (45 GW)*
Fuel & Investment Limitation	Gas Only	345 kV Overlay (25 GW)

*Timelines and development of this case are currently uncertain.

Spaghetti Diagrams

Help to:

- Visualize the relationship between the drivers
- Ensure that the drivers are widely (and logically) spread across the futures

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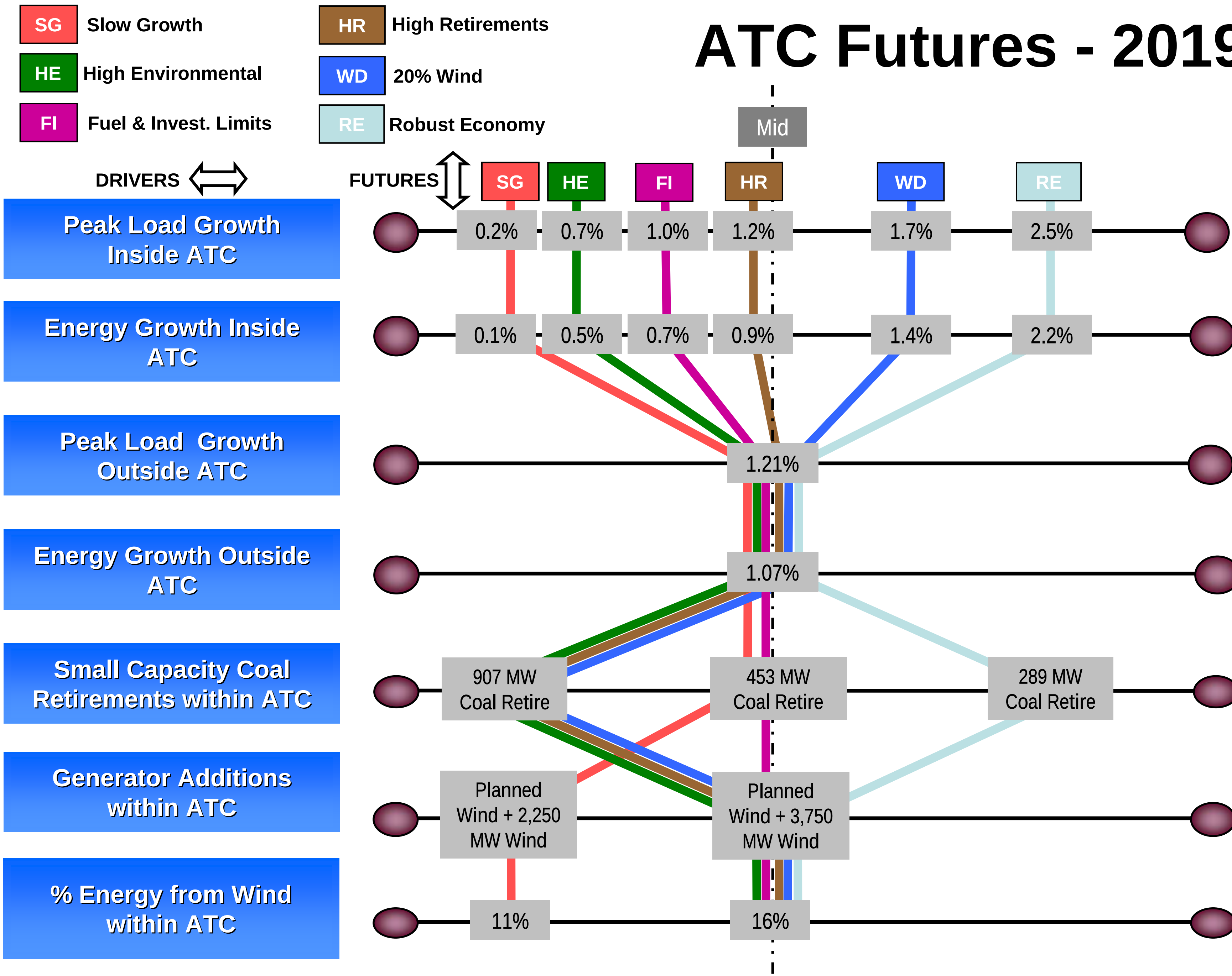
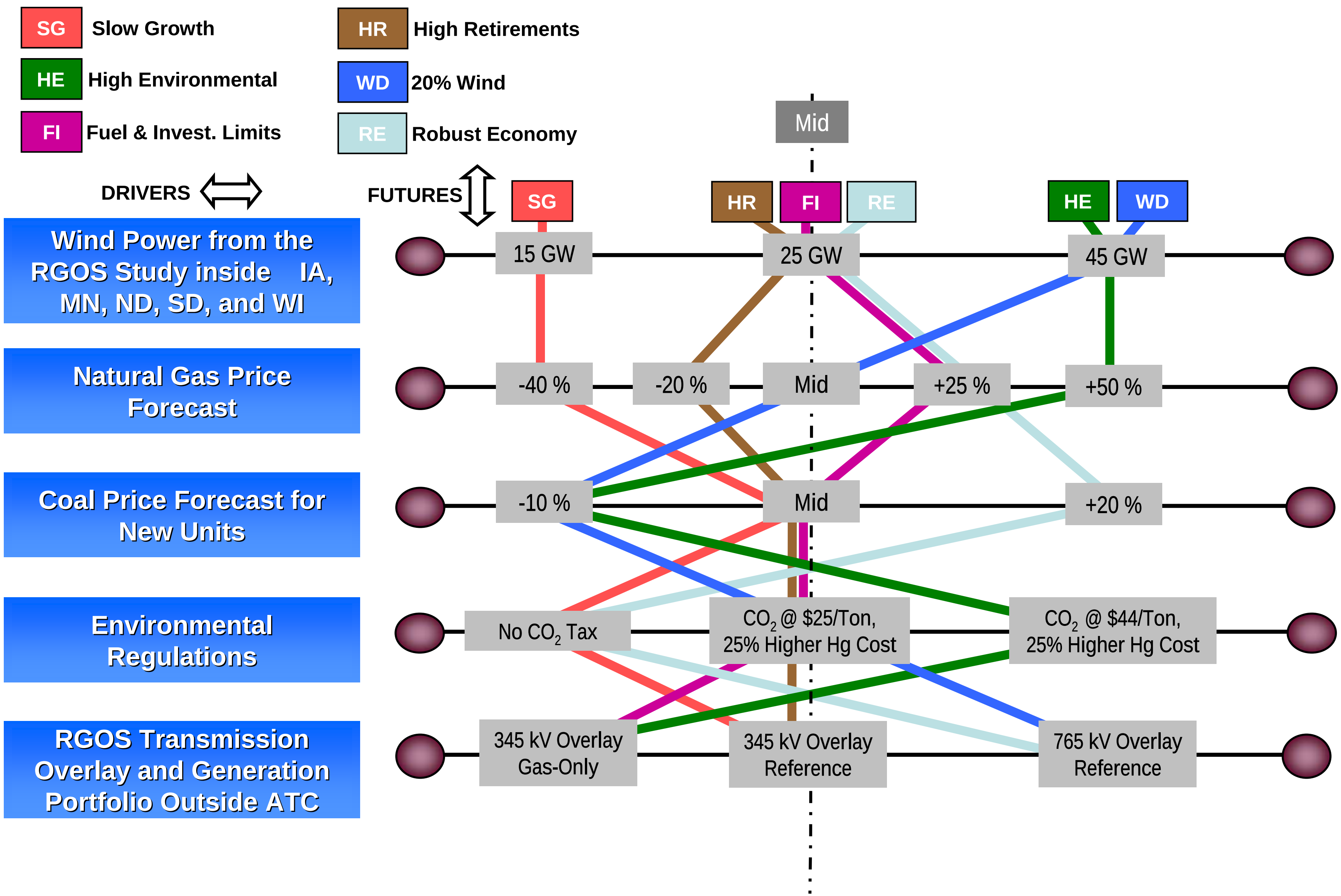
ATC Futures - 2019

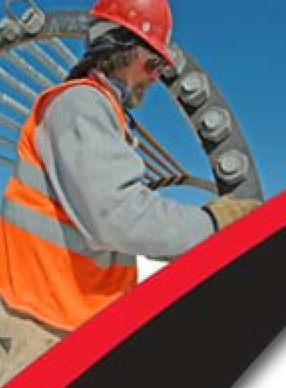


ATC Futures - 2019



Narrative Descriptions

- Handout describes the futures and the logical linkage between the drivers in each future
- Would appreciate your review and any comments you might have on the descriptions



Questions?

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