Future 3
Soft Constraints
Transfer Limit Hardening

NEEM-TX Subteam

SSC Meeting

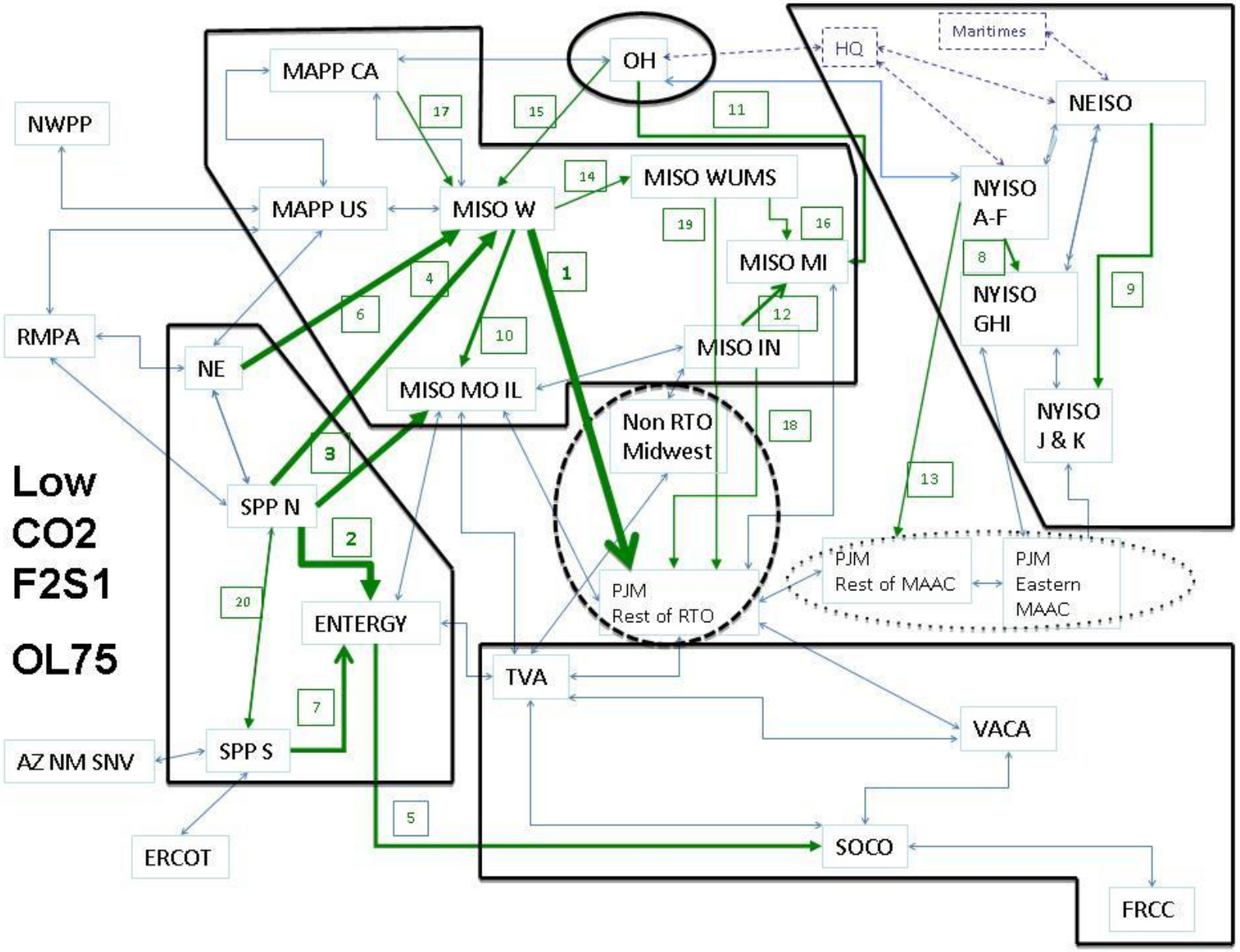
June 21, 2011

F3 Subteam Recommendation

F3 OL75	RHC	Johnson	NGO	Average
NYISO_A-F_2_NYISO_G-I	2227	1705	848	1593
MISO_WUMS_2_MISO_MI	864	1056	2048	1323
MISO_IN_2_MISO_MO-IL	91	0	1507	533
NEISO_2_NYISO_J-K	52	413	575	347
MAPP_CA_2_MISO_W	677	0	0	226
IESO_2_MISO_MI	0	613	0	0
IESO_2_NYISO_A-F	0	404	0	0
MISO_W_2_MISO_MO-IL	0	0	346	115
MISO_WUMS_2_MISO_W	0	0	308	103
MISO_IN_2_MISO_MI	62	0	0	21
IESO_2_MISO_W	0	42	0	0
SPP_N_2_NE	0	0	7	2

- Average initially showed increases for three IESO lines, but they were reduced to 0 due to the regional future constraint against increasing transfer limits between super-regions

Subteam recommends using the “Average” transfer limit increases shown above for the remaining sensitivities of F3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OL75
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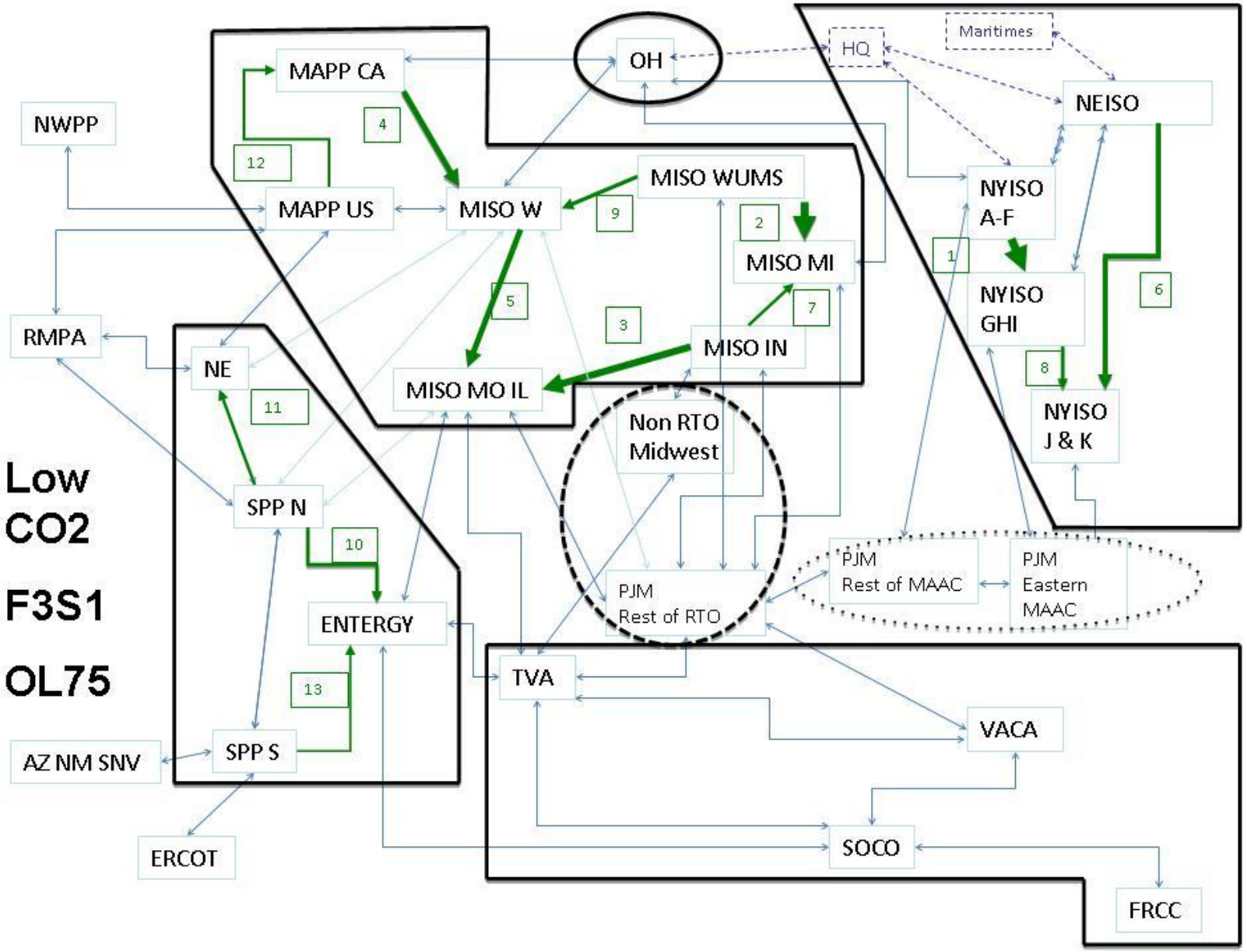
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OL75 TLH Comparison

TLH OL75	F1S1	F2S1	F3S1
SPP_N_2_ENT	0	13,843	0
MISO_W_2_PJM_ROR	0	12,420	0
NE_2_MISO_W	0	2,489	0
SPP_N_2_MISO_MO-IL	0	2,019	0
SPP_S_2_ENT	0	1,992	0
ENT_2_SOCO	0	1,900	0
NYISO_A-F_2_NYISO_G-I	507	1,435	1,593
MISO_IN_2_MISO_MI	0	768	21
IESO_2_MISO_MI	0	751	0
MISO_WUMS_2_MISO_MI	977	688	1,323
SPP_N_2_MISO_W	0	337	0
NEISO_2_NYISO_J-K	82	315	347
MISO_IN_2_PJM_ROR	0	261	0
SPP_N_2_SPP_S	0	236	0
NE_2_SPP_N	555	160	0
MISO_W_2_MISO_MO-IL	0	122	115
NYISO_J-K_2_PJM_E	35	74	0
IESO_2_MISO_W	156	67	0
MISO_W_2_MISO_WUMS	0	38	0
MISO_WUMS_2_MISO_W	892	0	103
MISO_W_2_MAPP_CA	227	0	0
MISO_MO-IL_2_MISO_W	167	0	0
IESO_2_MAPP_CA	62	0	0
NEISO_2_NYISO_G-I	62	0	0
IESO_2_NYISO_A-F	19	0	0
MISO_IN_2_MISO_MO-IL	0	0	533
MAPP_CA_2_MISO_W	0	0	226
SPP_N_2_NE	0	0	2

- Red for F3 denotes lines that are not allowed to expand in Regional Futures
  - Many of these lines likely would not have expanded much judging by shadow prices
- F1S1 is based on old BAU assumptions (EPA regs, landfill gas, etc.)
- TLH-specified transmission increase was not used for F1

Comparison of Cost Savings

Sensitivity	Present Value of Savings (relative to future base run, in millions)		
		Aggregate TX Increase (MW) called for by TLH methodology	Savings/MW TX Increase (in millions)
F1S1 (OL75)	$3,560	3,741	$0.95
F2S1 (OL75)	$67,700	39,915	$1.70
F2S11	$68,390	39,915*	$1.71
F3S1 (OL75)	$8,000	4,263	$1.88

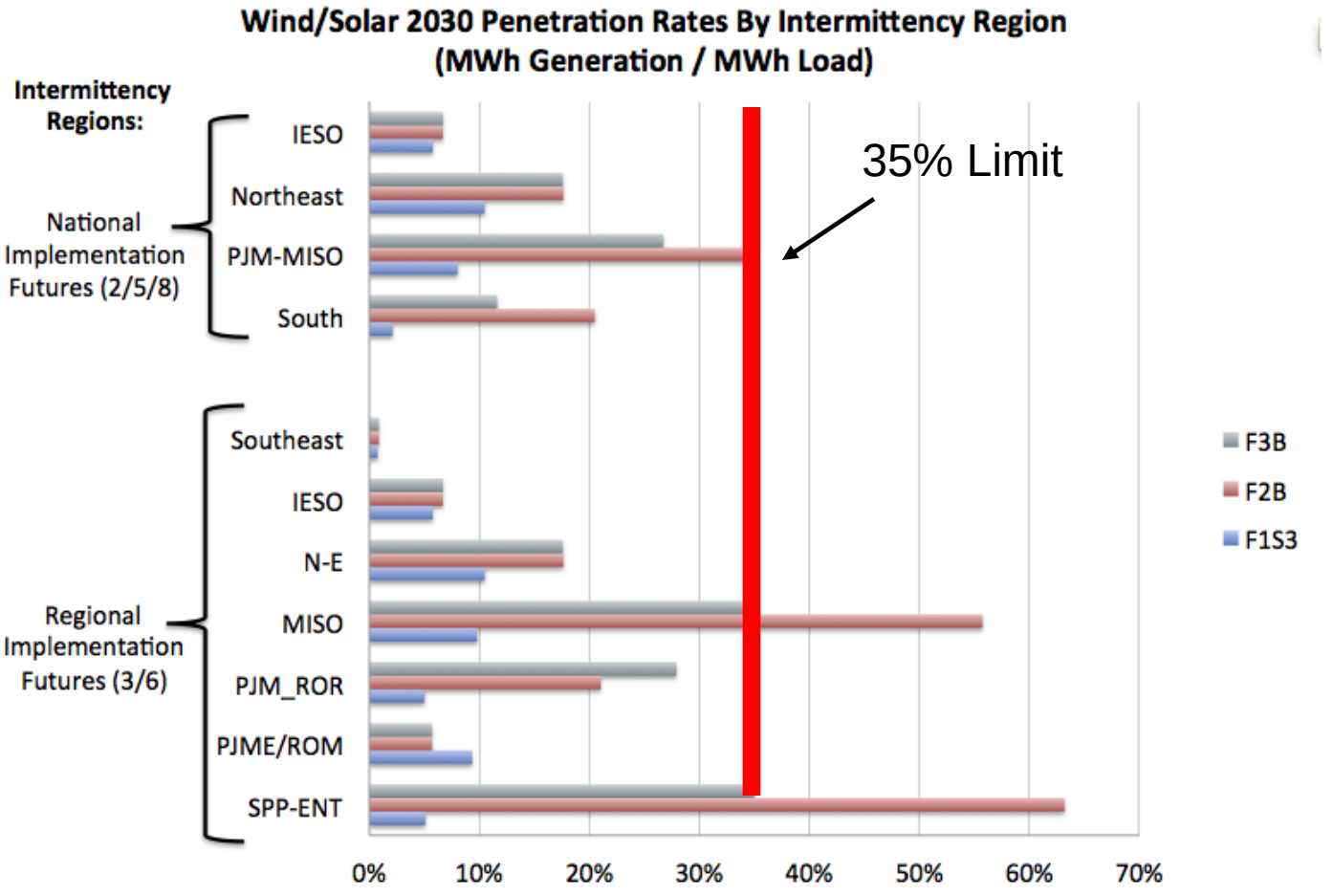
- Savings represent reductions in CRA's "Total Cost" results for all NEEM regions in the Eastern Interconnection combined assuming a 5% discount rate. Does not include transmission costs.
- Transfer limit expansions represent the sum of all suggested new capacity applying the Transfer Limit Hardening (TLH) methodology to the OL75 sensitivity flows.

  * F2S11 aggregate TX increase is the actual increase utilized in the F2 sensitivities based on F2S1 results. F2S11 is identical to F2S1 except that transfer limit increases are hardened and overload charges are not applied for use of increased transfer limits.

NEEM/TX Subteam Notes

- Large difference between F2S1 and F3S1 flows likely due to smaller intermittency regions
  - F2 has 4 intermittency regions (PJM/Midwest, South, Northeast, Ontario), F3 has 7 (equal to super-regions)
    - Larger F2 intermittency regions used because increased inter-regional transmission should allow for more localized intermittency penetration. With no inter-super-region transmission in F3, intermittency regions should be smaller
  - Smaller intermittency regions likely prevents the level of wind build necessary to create significant differences in shadow prices
- Even if inter-super-region transfer limit increases allowed, Subteam believes there would not be large increases due to the intermittency constraints

Intermittency Penetration Rates



Shadow Prices

	F1B	F1S3	F2B	F3B
IESO_2_MISO_MI	$1.59	$1.12	$41.04	$36.44
IESO_2_MISO_W	$3.28	$1.27	$32.36	$33.15
IESO_2_NYISO_A-F	$0.16	$0.11	$32.11	$26.51
SPP_N_2_ENT	$ -	$ -	$25.96	$ 1.36
SPP_S_2_ENT	$0.08	$0.07	$25.94	$ 1.60
IESO_2_MAPP_CA	$2.55	$0.64	$25.60	$22.59
SPP_N_2_MISO_MO-IL	$ -	$ -	$22.08	$ 0.40
MISO_W_2_PJM_ROR	$ -	$0.01	$13.39	$ 4.28
NYISO_A-F_2_NYISO_G-I	$1.51	$1.51	$12.57	$12.67
NE_2_MISO_W	$ -	$ -	$12.28	$ 0.00
SPP_N_2_MISO_W	$ -	$ -	$12.02	$ 0.06
NEISO_2_NYISO_J-K	$2.03	$2.27	$11.28	$11.41
NEISO_2_NYISO_G-I	$1.59	$1.52	$11.15	$11.26
MISO_W_2_MISO_WUMS	$0.05	$0.06	$11.10	$ 3.18
MISO_W_2_MISO_MO-IL	$ -	$ -	$10.38	$ 4.22
MAPP_CA_2_MISO_W	$1.38	$0.74	$10.05	$14.40
NYISO_A-F_2_PJM_ROM	$0.32	$0.23	$ 8.57	$ 8.43
NE_2_MAPP_US	$ -	$ -	$ 8.25	$ -
MAPP_CA_2_MAPP_US	$0.10	$0.03	$ 5.56	$ 8.43
MISO_W_2_MAPP_CA	$1.70	$1.84	$ 3.51	$ 0.32

- F1B – higher shadow prices between RPS/Hydro/Nuclear Regions relative to high coal retirement regions
  - F1S3 (revised BAU) decreased dynamic in certain areas due to lower coal retirements
- F2B – very high shadow prices between large low-carbon **potential** regions (wind) relative to other regions
  - Some exporting regions have greater than 100% intermittency penetration
- F3B – high shadow prices between regions with large low-carbon **existing** fleet (Nuclear/Hydro) regions relative to other regions
  - Wind much less of a factor due to more quickly reaching the intermittency limit given the smaller intermittency regions

NEEM/TX Subteam Notes

- High Carbon Tax leads to retirement of Coal and replacement with Wind (built to intermittency limit), Gas and Nuclear
- F2 wind generation replaced by Gas in F3
  - F2S1 2030 Gen: 30% Wind, 27% Gas
  - F3S1 2030 Gen: 18% Wind, 37% Gas
- Regions w/out Nuclear/Hydro fleets look very similar
  - Retirement of Coal with Gas as marginal generation due to lower Wind build equalizes generation costs
  - Little need for transmission between regions with similar marginal prices

NEEM/TX Subteam Notes

- Lower load levels (due to Carbon Tax) eases pressure on increasing inter-regional transfer limits
- Post-2030 high carbon tax levels (needed to decarbonize other sectors of the economy to reach 80% reduction) could be subtly affecting 2030 builds in certain regions which could in turn affect transfer limit flows
  - A sensitivity testing a lower post-2030 Carbon price might be useful