Renewable energy scenarios for SD 2040

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Renewable Energy Technology (and sources)	units	Baseline 2012 (Klimaat-monitor) all in TJ	Scenario #I 'Delta Zeeland'	Provision [TJ]	Scenario #II 'Ondernemend Zeeland'	Provision [TJ]	Scenario #III 'Avontuurlijk Zeeland'	Provision [TJ]	Scenario #IV 'Voedselrijk Zeeland'	Provision [TJ]	Notes and references
Nature of renewable energy intervention			Large scale interventions		Large scale interventions		Small scale interventions		Small scale interventions		
Presence and nature energy-related policies & legislation			Strong policies and legislation		Absence of policies and legislation		Absence of policies and legislation		Strong policies and legislation		
Energy source: Water											
(1) Tidal energy plant	#	0	1	315	1	315	1	315	1	315	capacity is 630 TJ (Hendriks, 2014) half accounted for SD and half for GO
(2) Osmotic power plant	#	0	1	470	-	0	-	0	-	0	capacity is 940 TJ but only half accounted for SD (Looman & Verhoeven, 2012)
Energy source: Solar											
(3) PV park on land (field with photovoltaic panels)	ha	0	-	0	100	963	-	0	-	0	38,5 TJ/ha on SD (Leenaers et al. 2012); est. future efficiency 25%; net provision = 9,625 TJ/ha
(4) PV park on water (photovoltaic panels)							10	96			10ha surface for now (this is the size of average PV parks, as reference) 38,5 TJ/ha on SD (Leenaers et al. 2012) est. future efficiency 25%; net provision = 9,625 TJ/ha
(5) Photovoltaic panels on building roofs (PV roofs)	ha	3	(-)	4	(-)	4	120	1,159	120	1,159	38,5 TJ/ha on SD (Leenaers et al. 2012) est. future efficiency 25%; net provision = 9,625 TJ/ha; roof surface 397 ha (CSB, 2013); 30% of all roofs techn. feasible (120ha)
Energy source: Wind											
(6) 3 MW wind turbines in wind park(s)	#	0	83	2,042	68	1,673	-	0	-	0	3 MW capacity at 8,5 m/s wind speed (Leenaers et al. 2012) with 26% operating time = 6834 mWh/yr = 24,6 TJ/yr per turbine (space requirement is about 13ha/turbine)
(7) Individual or small clusters of 3MW turbines	#	9	(-)	14	(-)	14	71	1,760	77	1,908	3 MW capacity at 8,5 m/s wind speed (Leenaers et al. 2012) with 26% operating time = 6834 mWh/yr = 24,6 TJ/yr per turbine (space requirement is about 13ha/turbine)
Energy source: Underground											
(8) Building-scale closed heat-cold storage (WKO)	ha	0	-	0	-	0	150	<1	150	<1	total built-up area = 1016 ha (CBS, 2010), only feasible in Burgsluis and Bruinisse (150ha) with 25W/m2 (Stremke et al. 2013) = 0,0009 TJ/ha
(9) Large open heat-cold storage (WKO/brondoublet)	#	0	10	45	-	0	-	0	-	0	Per brondoublet average of 1260 MW/yr (heat for 150 houses) = 4,5 TJ/year (IF Technology, 2009)
(10) Geothermal energy plant near Brouwersdam	#	0	1	79	1	79	-	0	-	0	Capacity heat production geothermal energy plant for houses in Brouwersdam (2,5 MW; reference Zierikzee Zuid 0,3 MW; Zierikzee Noord 0,5 MW) with 50% probability = 21.900 MW/yr = 79 TJ (Panterra, 2011)
Energy source: Biomass											
(11) Use of 2nd generation woody biomass in large combined heat-power plant	ha	?	932 ha forest (extensive use)	16	-	0	-	0	-	0	932 ha forest (CBS, 2010) with 0,042 TJ/ha (Ecofys, 2011) and 40% efficiency CHP plant = 16 TJ/yr
(12) Use of (local & imported) wood and pellets in individual, small furnaces	TJ	58	(-)	58	(-)	58	932 ha forest plus extg. import	66	932 ha forest plus extg. import	66	932 ha forest (CBS bodemgebruik, 2010) with 0,042 TJ/ha (Ecofys, 2011) and 20% efficiency of furnances = 8 TJ/yr
(13) Dedicated energy crops in combined heat power plant (CHP)	ha	0	7900 ha (50% of agricultural land)	419	7900 ha (50% of agricultural land)	419	-	0	-	0	Total agricultural land 15881 ha (CBS, 2011); energy corn 0,133 TJ/ha (Alterra, 2008); biogas combusted in CHP (40% efficiency) 0,053 TJ/ha
(14) Use of aquatic biomass in combined heat power plant (CHP)	ha	0					932 ha aquatic biomass production	49			932 ha surface (same as forest, as reference), energy corn as reference because no robust figures on aquatic biomass = 0,133 TJ/ha (Alterra, 2008); biogas inserted in gas network & combusted in micro CHPs (40% efficiency) 0,053 TJ/ha
other energy sources and technologies	div.	48	(-)	71	(-)	71	(-)	71	(-)	71	From Klimaatmonitor (e.g. heat recovery from melk cooling) average 50% increase due to technological innovation between 2012 and 2040
Total estimated energy provision by 2040 (estimated consumption by 2040 is 3525 TJ)	**TJ**	**117**		**3,532**		**3,523**		**3,517**		**3,519**	

Legend
applied
(-) current locations
minus = not applied

Changes	Date	Motivation
Scenario II, NRG #4: from x to (-)	141103	PV on roofs cannot be considered a large-scale intervention
Various changes indicated in beige	141107	Discussion with fellow DEESD researchers
Update references	141204	Streamlining spreadsheet and text file with explanation