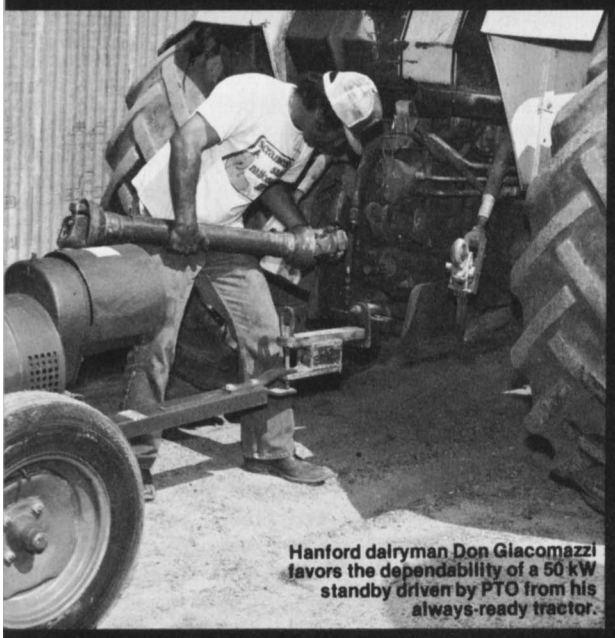
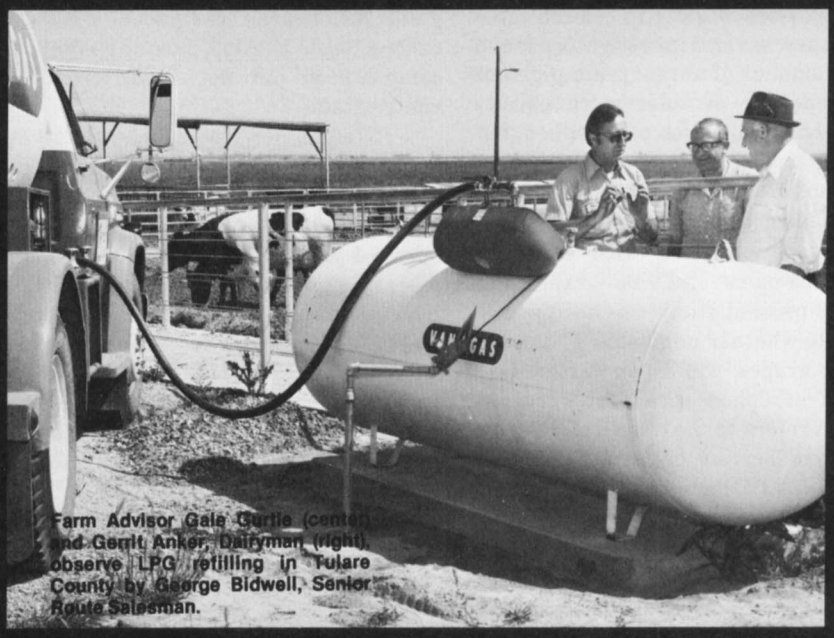
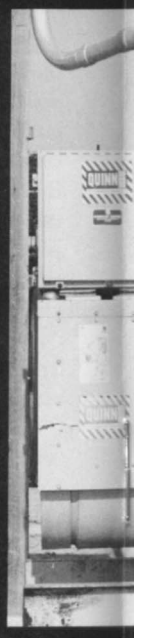


Hanford dairyman Don Giacomazzi favors the dependability of a 50 kW standby driven by PTO from his always-ready tractor.



Farm Advisor Gale Gurtle (center) and Gerrit Anker, Dairyman (right), observe LPG refilling in Tulare County by George Bidwell, Senior Route Salesman.



Energy supplies for milking parlors

William C. Fairbank ■ Richard N. Eide ■ Gale G. Gurtle ■ Herbert S. Etchegaray

The electrically powered milking and refrigeration equipment in dairy milking parlors is generally conceded to have high energy use effectiveness in terms of food production. The several hundred gallons of hot water needed to clean and sanitize the milking system twice each day and warm water for cow preparation and general washup may be heated by natural gas (NG), liquified petroleum gas (LPG), or electricity (kW), but there is no practical alternative to the electric motor to drive the vacuum pump, water pressure system, and refrigeration compressor, so most attention to dairy energy conservation is now directed towards the substantial water heating load.

Public health regulations protect the quality of milk by requiring a high level of sanitation and refrigeration, but they also leave producers vulnerable to power outage or fuel interruption. Utility companies serving dairy communities foresee natural gas curtailment and rotating electric outages in the near future. Evaluation of this critical load is needed so that alternative energy sources or modified energy use can be considered.

Farm-owned standby electric generators are part of the dairy energy mix. When they were installed, it was usually so that milking operations could continue during power outages. They now have added significance to the utility companies, because extensive use of standby generators could mitigate region-wide milking problems and losses caused by rotating outages. Large standbys could be operated under the new principle of "load sharing," which means that they would help the utility to carry part of the demand on that grid. In effect, parlors on large dairies whose milking operations are nearly continuous (for example, 20 hours per day) could be shifted entirely to off-peak load. (The lower, off-peak power rate that the account would then receive would amount to an accelerating pay-back as electricity cost continues to rise.)

In the spring of 1977, the Extension Dairy Energy Committee (DEC) surveyed producing dairies in Kings, Tulare, and Fresno counties. An inventory was made of the form of prime energy used for water heating, the size and fuel consumption rate of water heaters, and the on-dairy availability and size of standby electric generators for milking parlor loads. Milk inspectors and Dairy Herd Improvement Association (DHIA) supervisors gathered much of the data. Information was recorded from 100 percent of the dairies in Kings and Tulare counties and 39 percent of those in Fresno County (see table).

Discussion

Fuel used reflects the popularity during the 1960s of "all electric dairying." In Fresno and Tulare counties, however, a post World War II dairy barn building boom predated the big switch to electricity. LPG, the only practical alternative to NG, was the energy of economic choice. Kings County, however, had a relatively small dairy population when the southern San Joaquin dairy industry expansion began, so it had a higher percentage of total electrification of facilities. Future availability and cost of electricity could not be foreseen as factors that would ultimately challenge the use of the "most perfect energy" for water heating.

Water heaters on surveyed dairies range in size from 30 to 300 gallons. Most of the smaller tanks are on older, smaller dairies, where milking system washing is usually less labor-efficient than on modern very-large-pipeline (VLP) installations. (These small dairy operations are rapidly being replaced or modernized.) The most common size of tank in recent installations is 100 gallons.

Five percent of the dairies have two or more water heaters with a combined capacity of 70 to 300 gallons (200 gallons was most common). Having more than one small tank in an old parlor was a way to increase washing system capacity with the relatively small cost of an add-on heater. In newer installations, multiple tanks are usually chosen over large single tanks, because local equipment dealers stock just one size for obvious seller and buyer advantage. (The 100-gallon size is the most adaptable to any dairy situation.)

A concurrent DEC study of hot water consumption in milking parlors (*California Agriculture*, January 1978)

A.B. Dicks, Herdsman at Western Dairies, Inc., inspects dieselized 155 kW standby adequate to power the entire dairy.

SUMMARY OF DATA FROM SURVEY OF DAIRIES IN THREE CALIFORNIA COUNTIES, SPRING 1977

	Fresno	Kings	Tulare	Region	
Dairy Sample					
No. of dairies in county	145	142	237	524	
No. of reports	56	140	237	433	
Sample percentage	39	100	100	83	
Herd size					
Total cow population (includes dry)	56,000	51,000	103,000	210,000	
Total milking cows reported	14,882	37,080	76,533	128,495	
Avg. milking herd size reported	266	255	323	296	
Fuel used to heat water (no. of dairies)				**Total**	**%**
NG (natural gas)	12	22	27	61	17
LPG (propane)	24	56	72	152	43
kW (electricity)	20	58	58	136	40
Water heaters				**Total**	**%**
Capacity of tank(s), gal ⩽ 60	16	30	8	54	23
75-80	15	5	27	47	20
100	18	60	23	101	42
120	13	6	6	25	10
⩾ 150	8	3	2	13	5
Avg. size water heater tank, gal	81	91	95	88	—
No. of dairies with 2 or more tanks	13	7	3	23	5
Median total tank capacity per dairy with multiple tanks (gal)	175	175	200		175
Avg. total tank capacity per cow (gal)	0.37	0.32	0.37	0.34	
Avg Btu/hr rated input to gas each heater	94,125	139,000	167,000	151,000	—
Avg. kW demand on elec. heaters, @	**not reported**	—	—	—	—
Standby generators				**Total**	**%**
Dairies with standby	20	33	9	62	19
Dairies without standby	33	92	146	271	81
Cows with standby	7,754	11,389	5,865	25,008	24
Cows without standby	6,717	26,171	47,284	80,172	76
Standby self-powered	9	2	} 6	12	20
Standby PTO-driven	11	31		47	80
HP of drive engine, range	45-320	40-227	NR	—	—
HP of drive engine, avg.	91	83	NR	—	82
kW rating, range	40-250	35-194	NR	—	—
kW rating, avg.	85	55	NR	—	56

Basic Survey Form Used to Record Dairy Energy Use

			WATER HEATERS				STANDBY GENERATOR		
			#1		#2				
DAIRY	NO. OF MILKING COWS	FUEL/ENERGY NG LPG KW	GAL	HEAT INPUT RATE	GAL	HEAT INPUT RATE	YES/NO	KW	HP

indicated a hot water requirement for cleaning and sanitation of nearly 0.8 gallon per cow per day (0.4 gallon per milking) ± 0.2 gallon. With the average 100-gallon water heater and average herd of 296 milking cows, hot water use would be 0.34 gallon per cow per milking if the tank is completely "dumped" (the usual practice) at each washup. (Milk tanks are not washed at the same time as the pipeline, which would account for the discrepancy between 0.34 gallon for pipeline washing only and 0.4 gallon average total use.)

Heat input rate of gas burners and electric elements turned out to be questionable as recorded. Often it was not clear whether the input specified on the data plate was for each element or burner, or for the total. Also there is little uniformity of heat recovery rate in older installations, and the dual elements in electric heater tanks are sometimes improperly connected as a means of increasing hot water yield or otherwise manipulating performance. Energy use efficiency and electrical demand were not important factors when these heaters were installed.

Standby generator data are a little less than certain. Output capability was transcribed from the data plate but, as is not infrequent on farm equipment, the plate may have been missing, obliterated, or hidden from view, or the electrical specifications may have been misread. For example, the output may be stated: *50 kW continuous; 70 kW intermittent.* Comparisons should be on continuous duty only.

The horsepower input to a PTO generator, as reported or even directly observed, is no assurance that the tractor HP is reasonably mated to the maximum continuous rating of the standby unit. The HP and kW ranges and averages do, however, give reasonable indication of the general size of standby equipment on 19 percent of the dairies. But, the 81 percent of dairies or 76 percent of cows without standby means the electric utility companies have little hope of significant load-sharing capability at this time, and it emphasizes the loss potential from electrical outage.

All standby systems appeared adequate to energize the basic milking machine and essential pumps. Refrigeration, electric water heating, and parlor washup might have to be delayed on some dairies until the large vacuum pump motors are shut down, if the milking system has been expanded or modernized since the standby was installed. The few dairies with large, well-engineered and properly maintained standbys are usually prepared to carry the entire milking operation demand.

Contemporary milking parlors on large dairies are economically sized for 16 to 20 hours of operation per day. (Four hours of down-time is considered necessary for sanitation and maintenance.) Milk must be cooled at the same rate at which it is produced. Washup and sanitation require pressurized, hot, potable water. The fuel supply and standby system must be capable of carrying the milking machine, refrigeration equipment, water supply, and heater simultaneously if the operation is to be immune from an energy limitation of more than a few hours. This survey indicates a low level of immunity in the Fresno, Kings, and Tulare region.

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